PROPOSED ORDER OF
DEPARTMENT OF HEALTH SERVICES
TO ADOPT PERMANENT RULES

The Wisconsin Department of Health Services proposes an order **to repeal** DHS 157.09 (1) (a) 8. a.; DHS 157.43 (2) (b); DHS 157.83 (3) (b) 2. b.; and DHS 157.94 (8) (a) through (d); **to renumber** DHS 157.09 (1) (a) 8. b., c., and d.; DHS 157.13 (10) (b); and DHS 157.43 (2) (intro.) and (2) (a); **to renumber and amend** DHS 157.83 (3) (b) 2. a.; **to amend** DHS 157.03 (200) (c), (208), (221m), (404), and (419m); DHS 157.09 (1) (a) (intro.), (1) (a) 5. a. and b., (1) (a) 10. (intro.), (2) (c) 7., and (2) (d) 1., 2., and (e) 1.; DHS 157.11 (2) (a); DHS 157.13 (1) (h) (intro.) and 1., (1) (i), (4) (e), (f) and (h) 2., and (10) (e) 2.; DHS 157.15 (1) (a) 2. and 4., (5) (a) (intro.), 1., and 3., and (5) (b); DHS 157.21 (1); DHS 157. 22 (1) (e) (Note), (4) (h) 2., (5) (d) 1. and (Note); DHS 157.24 (1) (b) (intro.); DHS 157.25 (1) (a) 1., 2. (intro.), (1) (a) 2. b. and c., and (2) (a) 5.; DHS 157.36 (1) (a) (Note); DHS 157.44 (6) (a) 4.; DHS 157.61 (7) (a) 2. b, (8) (a) 1. b., and (10) (a) and (c); DHS 157.63 (2) (b) 3. and (4) (c) 2.; DHS 157.67 (11) (f) and (12) (b) 3.; DHS 157.71 (8); DHS 157.72 (1) (a) 1.; DHS 157.74 (2) (b) 2., (d) 3., (f), and (h) 1. and 4. c., (3) (b) 2. and (4) (b); DHS 157.76 (11) (a); DHS 157.77 (2) (h) 1., and (i); DHS 157.78 (4) (d) 1. and 3., (8) (title), and (9) (a); DHS 157.79 (3) (c); DHS 157.80 (1) (b) (intro.); DHS 157.83 (3) (b) 4. d.; DHS 157.85 (3) (title), (13) (em) 2. through 7., (14) (gm) (intro), and (16) (g) 7. d.; DHS 157.87 (1) (intro.), (3) (b) 6., and (4) (a); DHS 157.92 (2) (b) 1. and 2., and (c) 4.; DHS 157.94 (5) (a), (c) 4., (d), (e), (f), and (8) (intro.); **to repeal and recreate** DHS 157.03 (84m) and (Note), and (198); DHS 157.09 (1) (a) 11. and 12.; DHS 157.10 (3); DHS 157.11 (1) (a); DHS 157.15 (5) (a) 2.; DHS 157.76 (7) (c); DHS 157.87 (1) (a); DHS 157.93 (4) (b) and (6); DHS 157.94 (3) and (6); DHS 157 Appendix A, Appendix B, Appendix E, Appendix H Table V; Appendix I; Appendix M; and Appendix O; **to create** DHS 157.01 (16); DHS 157.03 (6m), (12m) and (Note), (25m), (36m), (56g) and (Note), (56r) and (Note), (77m), (108m), (109m), (124g), (139m), (143g), (150g), (166m), (189m) and (Note), (193m), (215m), (219m), (221m) (Note), (228m), (230m), (318m), (319g), (319r), (331g), (331r), (374m), (392m), (393m), and (402g); DHS 157.09 (1) (a) 13., (2) (c) 9. through 11., (2) (e) 4. and (g), and (3); DHS 157.13 (1) (h) 3. through 5.,(4) (d) 1. h. and (j) 5., (4m), (10) (b) 2.; DHS 157.15 (5) (a) 1. e. and f. and (c); DHS 157.25 (1) (d); DHS 157.33 (3) (a) 4.; DHS 157.61 (10) (d); DHS 157.74 (2) (m); DHS 157.76 (7) (d); DHS 157.78 (10); DHS 157.80 (1) (f) 5. and 6., (2) (a) 1., (b) 4., and (c); DHS 157.83 (3) (b) 1.; DHS 157.84 (1) (b) 5.; DHS 157.85 (14)(gr); DHS 157.87 (1) (ag) and (ar), (4) (c), (d), and (e); DHS 157.92 (2) (b) 3.; DHS 157.93 (4) (am); DHS 157.94 (5) (am) and (Note); DHS 157 Subchapter XV; and DHS 157 Appendix U; relating to radiation protection.

RULE SUMMARY

Statute interpreted
Sections 254.31 to 254.45, Stats., and 42 USC 2011 to 2114.

Statutory authority
Sections 227.11 (2) (a), 254.34 (1) (a) and (b), 254.35 (3) (g), 254.365 (4), and 254.37 (3), Stats.

Explanation of agency authority

As specified under s. 254.34 (1), Stats., the department is the state radiation control agency and is required under ss. 254.34 (1) (a), 254.365 (4), and 254.37 (3), Stats., to promulgate rules pertaining to the use of radiation in Wisconsin. Specifically, the department is required to promulgate and enforce rules pertaining to sources of ionizing radiation and for registration and licensing sources of ionizing radiation, and enforcement as may be necessary to prohibit and prevent unnecessary radiation exposure. The department's rules for by-product material, source material, and special nuclear material are required to be in accordance with 42 USC 2021 (o) and be otherwise compatible with the requirements under 42 USC 2011 to 2114 and regulations adopted under 42 USC 2011 to 2114.

Related statute or rule

Chapter NR 809 incorporates the radioactivity standards for community water systems and the exemptions and requirements established in ss. DHS 157.95 and 157.96. The department of natural resources applies these standards to community drinking water systems.

Chapter DHS 163 establishes requirements for identification, removal and reduction of lead-based paint hazards. Lead in paint analysis requires use of a portable device containing radioactive material which is required to be licensed under ch. DHS 157. Section DHS 157.05 (4) also requires any person providing training for certified lead inspectors or risk assessors to meet the training requirements of s. DHS 163.24 (a) 1. and 3. and to complete an additional eight hours of radiation safety training.

Chapter 462, Stats., requires radiographers to be licensed and limited x-ray machine operators to be permitted by the state. Sections DHS 157.74 (2) (m) and 157.80 (2) (a) 1. also require individuals operating x-ray equipment for diagnostic purposes to possess a current radiography license or limited x-ray machine operator's permit from the State of Wisconsin.

Plain language analysis

Under s. 254.34 (1) (a) and (b) Stats., the department is responsible for developing and enforcing rules, including registration and licensing of sources of ionizing radiation, to prohibit and prevent unnecessary radiation exposure. The department is also responsible for maintaining compliance with the *Agreement Between The United States Nuclear Regulatory Commission and The State of Wisconsin for Discontinuance of Certain Commission Regulatory Authority and Responsibility Within the State Pursuant to Section 274 of the Atomic Energy Act of 1954, as Amended* (agreement) signed by Governor Doyle and the Nuclear Regulatory Commission (NRC) in 2003. The agreement transferred regulatory authority over certain radioactive materials from the NRC to the state. Under the Agreement, the department is responsible for licensing and inspecting radioactive materials commonly used in medicine, industry, research and education. The state regulatory program is periodically evaluated by NRC staff.

The Agreement provides that the state will revise the radioactive material provisions of ch. DHS 157 within three years of any applicable changes to Title10 CFR. Title 10 CFR was revised in 2013, whereas ch. DHS 157 was last revised in 2010. The department proposes to revise the radioactive material requirements in ch. DHS 157 in order to comply with the Agreement. No reasonable alternative exists to revising provisions in ch. DHS 157 pertaining to radioactive material, because the Agreement remains in effect. The proposed revisions are anticipated to bring the state into compliance with the Agreement.

In addition, the department proposes to revise provisions of ch. DHS 157 pertaining to x-rays. These revisions are necessary to prohibit and prevent unnecessary radiation exposure. Revisions reflect new diagnostic and therapeutic technologies, the department's experience with implementing and administering the current rule, changes in comparable federal regulations, suggested national standards from the Conference of Radiation Control Program Directors, and input provided to the department by an advisory group that included representatives of academic and medical facilities, radioactive materials users, x-ray users and large and small businesses. No reasonable alternative exists to revising the provisions of ch. DHS 157 pertaining to x-rays, because pursuant to s. 254.34, stats., the department must promulgate and enforce rules, including registration and licensing of sources of ionizing radiation, as may be necessary to prohibit and prevent unnecessary radiation exposure. The proposed revisions are anticipated to accomplish this purpose.

The proposed revisions to ch. DHS 157 accomplish the following:

- Update the radiation protection and regulatory requirements for radioactive materials to ensure compatibility with current applicable regulations of the federal Nuclear Regulatory Commission (NRC) in 10 CFR Parts 19, 20, 31-37, 39, 40, 70, 71 and 150, relating to notices, instructions and reports to workers regarding inspections and investigations; standards for protection against radiation; general domestic licenses for byproduct material, specific domestic licenses to manufacture or transfer certain items containing byproduct material; specific domestic licenses of broad scope for byproduct material; licenses for industrial radiography and radiation safety requirements for industrial radiographic operations; physical protection of byproduct material; medical use of byproduct material; licenses and radiation safety requirements for irradiators; licenses and radiation safety requirements for well logging; domestic licensing of special nuclear material; packaging and transportation of radioactive material; and exemptions and continued regulatory authority in agreement states and in offshore waters.

- Compatibility with current applicable regulations of the federal Food and Drug Administration (FDA) in 21 CFR Parts 900, 1020, 1030, and 1040, relating to mammography quality standards, performance standards for ionizing radiation emitting products; microwave and radio frequency emitting products; and light-emitting products for the protection against hazards of radiation.

- Codification of suggested national standards for x-ray device imaging from the Conference of Radiation Control Program Directors in the *Suggested State Regulations for the Control of Radiation*.

- Conformity with ch. 462, Stats., relating to licensing and the practice of radiographers and limited x-ray machine operators by removing any conflicts with ch. 462. Stats., or rules promulgated thereunder by the radiography examining board.

- Correct rule language based on the Department's experience administering the current rule.

The department had initially proposed to require recording of a patient's radiation dose in the medical record for certain high dose medical procedures as recommended by the Food and Drug Administration. However, based on input received from an advisory group, the department determined that this requirement is not feasible at present because existing methods for estimating patient exposure are inadequate.

Entities that may be affected by the proposed revisions to ch. DHS 157 are hospitals, academic facilities, medical clinics, dental facilities, chiropractic offices, veterinary facilities and industrial facilities that use radioactive materials or x-ray devices.

Summary of, and comparison with, existing or proposed federal regulations
Wisconsin's Agreement with the Nuclear Regulatory Commission requires the department to incorporate relevant changes to federal radioactive material regulations into its radiation protection rules within three years of the effective date of the federal regulations. The proposed changes to ch. DHS 157 ensure continued compatibility with new federal radioactive material regulations in 10 CFR Pts. 19, 20, 31, 33-36, 37, 39, 40, 70, 71 and 150, and 49 CFR as required by s. 254.34 (1), Stats.

Comparison with rules in adjacent states

Illinois:
Illinois is an agreement state with the Nuclear Regulatory Commission. As a result, Illinois law in effect June 1, 2016 contains radiation protection and regulatory requirements similar to those contained in ch. DHS 157 and compatible with equivalent federal regulations in Titles 10 and 49, CFR.

Iowa:
Iowa is an agreement state with the Nuclear Regulatory Commission. As a result, Iowa law in effect June 1, 2016 contains radiation protection and regulatory requirements similar to those in ch. DHS 157 and compatible with equivalent federal regulations in Titles 10 and 49, CFR.

Michigan:
Michigan is not an agreement state with the Nuclear Regulatory Commission. Michigan previously declared its intent to become an agreement state but later decided to cease all activity toward pursuing the agreement. As a result, Michigan law in effect June 1, 2016 contains some regulatory requirements similar to those in ch. DHS 157. The Nuclear Regulatory Commission is currently responsible for regulating the majority of radioactive material use in Michigan under Titles 10 and 49, CFR.

Minnesota:
Minnesota is an agreement state with the Nuclear Regulatory Commission. Minnesota adopted new radiation protection regulations for radioactive materials effective January 1, 2005. As a result, Minnesota law in effect June 1, 2016 contains radiation protection and regulatory requirements similar to those in ch. DHS 157 and compatible with equivalent federal regulations in Titles 10 and 49, CFR.

Summary of factual data and analytical methodologies
The department referred to all of the following to draft the proposed rules:

1. The input of an advisory committee that included stakeholders affected by the proposed rules. These included representatives of academic and medical facilities, radioactive materials users, x-ray users, and large and small businesses.

2. An agreement state rule template called the "Suggested State Regulations for the Control of Radiation" (SSRCR) developed by the Conference of Radiation Control Program Directors, Inc. (CRCPD). The CRCPD is a national organization of primarily state radiation control staff that supports and represents state radiation control programs. The SSRCR is developed with the involvement of federal radiation agencies, such as the Nuclear Regulatory Commission, the Food and Drug Administration and the Environmental Protection Agency. The SSRCR is also continually updated and used by most of the 37 existing agreement states to help meet federal requirements.

3. Requirements of Titles 10, 21, and 49 CFR; 42 USC; Sections 254.31 to 254.45, Stats., and the *Agreement Between The United States Nuclear Regulatory Commission and The State of Wisconsin for Discontinuance of Certain Commission Regulatory Authority and Responsibility Within the State Pursuant to Section 274 of the Atomic Energy Act of 1954, as Amended*.

Analysis and supporting documents used to determine effect on small business
The methods specified in s. 227.114 (2), Stats., for reducing a rule's impact on small business were considered by the department, but have not been adopted in the proposed rules because they are not feasible. Adopting the methods specified in s. 227.114 (2), Stats., would be contrary to the state's public policy on radiation control stated in s. 254.33, as well as federal requirements, and the agreement between the state and the NRC, which are the basis for the proposed rule. The department's analysis of the effect of rulemaking on small businesses regulated by ch. DHS 157 is therefore confined to proposed revisions addressing x-ray regulatory requirements.

The department's x-ray registration and inspection program, and radioactive materials licensing and inspection program, are both entirely supported by the annual fees authorized under s. 254.35 (3) and s 254.365 (5), Stats. There are no fee increases proposed in this rule revision.

Any fiscal impact to x-ray registrants may stem from proposed requirements in the following sections: DHS 157.21 (1), DHS 157.25 (2) (a) 5., DHS 157.74 (2) (m), DHS 157.77 (2) (h) and (i), DHS 157.78 (10), DHS 157.80 (1) (f) 5. and 6., DHS 157.80 (2) (a) 1., and DHS 157.85 (14) (gn). The proposed requirements and the fiscal impact on small business are as follows:

DHS 157.21 (1): The department proposes that any facility that uses an x-ray device designate a person in control who is responsible for safe operation of the radiation installation. This is already required for licensees who must designate a radiation safety officer. Since x-ray registrants may designate an existing staff person, the department anticipates minimal fiscal impact on any facility, including small businesses.

DHS 157.25 (2) (a) 5.: Fluoroscopic devices are capable of generating strong radiation fields when operational. Currently, radiation monitoring is required for any individual working within six feet of operating medical fluoroscopic equipment. This requirement does not allow any exception for individuals who may need to walk briefly past the device with minimal exposure. As a result, the department proposes to provide flexibility to medical facilities, including small businesses, by only requiring monitoring for individuals working within six feet of operating fluoroscopic equipment longer than 10 minutes per week. This is intended to reduce the radiation monitoring costs for facilities with these devices.

DHS 157.74 (2) (m): This paragraph refers to the existing requirement in s. 462.02(1) (a), Stats. that any individual who operates x-ray equipment for diagnostic medical purposes have a current radiography license or limited x-ray machine operators permit issued by the state. These licenses and permits are currently issued by the department of safety and professional services. The department anticipates no fiscal impact stemming from reference within DHS 157.74 (2) (m) to this existing requirement.

DHS 157.77 (2) (h) and (i): These two paragraphs clarify the operator protection requirements for all types of x-ray systems, including veterinary systems. Specifically, DHS 157.77 (2) (h) requires the x-ray control to be permanently mounted behind a protective barrier and DHS 157.77 (2) (i) requires persons within 2.7 meters (9 feet) to wear a protective apron with at least .25 mm of lead equivalence and have lead gloves of .5 mm lead equivalence if holding the animal. There is minimal effort required to meet these requirements, as existing equipment may be used. As a result, the department anticipates minimal fiscal impact on any facility.

DHS 157.78 (10): Hand held dental x-ray units are being increasingly used in dental offices and during public dental events. These devices are capable of exposing patients and operators to substantial radiation if used inappropriately. As a result, the department proposes minimum operator training for all personnel that operate hand held dental x-ray units. This training must include manufacturer-specific training in exposure control, operation, use of safety devices, operator and patient protection, and quality control testing. Affected entities are given flexibility in how to provide training, which may include in-house (on site) training, or training limited to the entity's particular use of x-ray units. In addition, the department proposes new radiation safety requirements specific to this technology to ensure operator and public safety during use. The requirements are drawn from the SSRCR published by the CRCPD. The department anticipates that there will be a small cost associated with the training, but little to no cost associated with the radiation safety requirements.

DHS 157.80 (1) (f) 5. and 6.: The department proposes to require that facilities using newer generation computed tomography(CT) systems ensure that two-way verbal communication exists between the patient and the operator of the device, and that a method be provided to permit continuous observation of the patient during irradiation. Although CT scans can produce a very detailed image of the body from multiple x-ray images or 'slices,' radiation exposure to the patient can be very high. These devices are used primarily in large medical facilities. The department anticipates no additional fiscal impact on facilities using these devices since the proposed requirements are consistent with CRCPD suggested state regulations and similar requirements that already exist in s. DHS 157.81.

DHS 157.80 (2) (a) 1.: This provision refers to the existing requirement in ch. 462, Stats., that individuals operating x-ray equipment for diagnostic medical purposes have a current radiography license or limited x-ray machine permit issued by the Department of Safety and Professional Services. The department anticipates no additional fiscal impact on facilities using these devices.

DHS 157.85 (14) (gn): Electronic brachytherapy is a new technology that uses small x-ray devices to treat cancer within the body. The devices are capable of producing very high levels of radiation. These devices tend to be used primarily in large medical facilities and not small businesses. Based on input from the advisory committee, the department proposes quality control requirements for these devices to ensure safe operation. The department anticipates no additional fiscal impact on facilities using these devices.

Effect on small business
Based on the foregoing analysis, the proposed rules are anticipated to have little to no economic impact on small businesses.

Agency contact person
Paul Schmidt, Chief
Radiation Protection Section
P.O. Box 2659
Madison, WI 53701-2659
paul.schmidt@dhs.wisconsin.gov

Statement on quality of agency data
The department utilized the input of an advisory committee representing entities affected by the proposed rules, a rule template called the "Suggested State Regulations for the Control of Radiation" (SSRCR) developed by the CRCPD, and applicable federal regulations. Please refer to the 'Summary of Factual Data and Analytical Methodologies' above for more detail.

Place where comments are to be submitted and deadline for submission
Comments may be submitted to the agency contact person that is listed above until the deadline given in the upcoming notice of public hearing. The deadline for submitting comments and the notice of public hearing will be posted on the Wisconsin Administrative Rules Website at http://adminrules.wisconsin.gov after the hearing is scheduled.

RULE TEXT

SECTION 1. DHS 157.01 (16) is created to read:

DHS 157.01 **(16)** Subchapter XV establishes requirements for the physical protection program for any licensee that possesses a category 1 or category 2 quantity of radioactive material listed in Appendix U.

SECTION 2. DHS 157.03 (6m), (12m) and (Note), (25m), (36m), (56g) and (Note), (56r) and (Note), and (77m) are created to read:

DHS 157.03 **(6m)** "Access control" means a system for allowing only approved individuals to have unescorted access to the security zone and for ensuring that all other individuals are subject to escorted access.

DHS 157.03 **(12m)** "Aggregated" means accessible by the breach of a single physical barrier that would allow access to radioactive material in any form, including any devices that contain the radioactive material.

Note: An aggregated total activity equal or exceeding a category 2 to quantity of radioactive material exceeds the thresholds set forth in Appendix U.

DHS 157.03 **(25m)** "Approved individual" means an individual whom the licensee has determined to be trustworthy and reliable for unescorted access under ss. DHS 157.100 to157.106 and who has completed the training required by s. DHS 157.108 (3).

DHS 157.03 **(36m)** "Background investigation" means the investigation conducted by a licensee or applicant for a license to support the determination of trustworthiness and reliability.

DHS 157.03 **(56g)** "Category 1 quantity of radioactive material" means a quantity of radioactive material meeting or exceeding the category 1 threshold in Appendix U of this chapter.

Note: This is determined by calculating the ratio of the total activity of each radionuclide to the category 1 threshold for that radionuclide and adding the ratios together. If the sum is equal to or exceeds 1, the quantity would be considered a category 1 quantity. Category 1 quantities of radioactive material do not include the radioactive material contained in any fuel assembly, subassembly, fuel rod, or fuel pellet. Appendix U is used to determine the category 1 threshold for a category 1 quantity of radioactive material. The category 1 and category 2 thresholds in Appendix U and Appendix T are not interchangeable.

DHS 157.03 **(56r)** "Category 2 quantity of radioactive material" means a quantity of radioactive material meeting or exceeding the category 2 threshold, but less than the category 1 threshold in Appendix U of this chapter.

Note: This is determined by calculating the ratio of the total activity of each radionuclide to the category 2 threshold for that radionuclide and adding the ratios together. If the sum is equal to or exceeds 1, the quantity would be considered a category 2 quantity. Category 2 quantities of radioactive material do not include the radioactive material contained in any fuel assembly, subassembly, fuel rod, or fuel pellet. Appendix U is used to determine the category 2 threshold for a category 2 quantity of radioactive material. The category 1 and category 2 thresholds in Appendix U and Appendix T are not interchangeable.

DHS 157.03 **(77m)** "Contamination" means the presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm2 (1x10-5 microCi/cm2) for beta and gamma emitters and low toxicity alpha emitters, or 0.04 Bq/cm2 (1x10-6 microCi/cm2) for all other alpha emitters.

SECTION 3. DHS 157.03 (84m) and (Note) is repealed and recreated to read:

DHS 157.03 (**84m**) "Criticality safety index" or "CSI" means the dimensionless number, rounded up to the next tenth, assigned to and placed on the label of a fissile material package to designate the degree of control of accumulation of packages, overpacks, or freight containers containing fissile material during transportation.

Note: Determination of the criticality safety index is described in s. DHS 157.93 (7) and (8). s. DHS 157.93 (7) and (8), and 10 CFR 71.59. The CSI for an overpack, freight container, consignment or conveyance containing fissile material packages is the arithmetic sum of the criticality safety indices of all the fissile material packages contained within the overpack freight container, consignment, or conveyance.

SECTION 4. DHS 157.03 (108m), (109m), (124g), (139m), (143g), (150g), (166m), (189m) and (Note), and (193m) are created to read:

DHS 157.03 **(108m)** "Diversion" means the unauthorized movement of category 1 or category 2 quantity of radioactive material that is subject to subch. XV to a location different from the material's authorized destination inside or outside of the site at which the material is used or stored.

DHS 157.03 **(109m)** "Dose length product" or "DLP" means the metric which is related to the total energy imparted in the patient, and is determined by multiplying the CTDIvol value by the scan length, resulting in the units of mGy-cm. DLP is calculated using the following formula:

$$DLP = \frac{L}{p}\left(\frac{1}{3}\mathrm{CTDI}_{100,\mathrm{cent}} + \frac{2}{3}\mathrm{CTDI}_{100,\mathrm{periphery}}\right)$$

where:

L = the length of patient scanned.
p = is the pitch.
CTDI100,cent = CTDI100 value determined at the center of a standardized phantom.

CTDI100,periphery = CTDI100 value determined at the periphery of a standardized phantom.

DHS 157.03 **(124g)** "Escorted access" means the continuous direct visual surveillance by an approved individual over an individual in the security zone who is not approved for unescorted access.

DHS 157.03 **(139m)** "Fingerprint order" means an order issued by the NRC, a license condition by the department, or a legally binding requirement issued by another agreement state that requires a fingerprints and criminal history records check for individuals who have unescorted access to category 1 and category 2 quantities of radioactive material or safeguards information-modified handling.

DHS 157.03 (**143g)** "Fixed contamination" means contamination that cannot be removed from a surface during normal conditions of transport.

DHS 157.03 **(150g)** "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government.

DHS 157.03 **(166m)** "Indian Tribe" means an Indian or Alaska native tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian tribe pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a.

DHS 157.03 **(189m)** "License verification system" means the national verification system that enables authorized government authorities and authorized licensees to verify certain information about licensees authorized to possess, use, or ship radioactive materials.

Note: The system may be used to confirm that a license is valid and accurate, a licensee is authorized to acquire quantities and types of radioactive materials, and the licensee's category 1 or 2 quantities of radioactive material inventories do not exceed the possession limits of the license.

DHS 157.03 **(193m)** "Local law enforcement agency" or "LLEA" means a public or private organization that has been approved by a federal, state, or local government to carry firearms and make arrests, and is authorized and has the capability to provide an armed response in the jurisdiction where the licensed category 1 or category 2 quantity of radioactive material is used, stored, or transported

SECTION 5. DHS 157.03 (198) is repealed and recreated to read:

DHS 157.03 **(198)** "Low specific activity – I" or "LSA-I material" means any of the following:

(a) Uranium and thorium ores, concentrates of uranium and thorium ores, and other ores containing naturally occurring radioactive radionuclides which are intended to be processed for the use of radionuclides.

(b) Natural uranium, depleted uranium, natural thorium or their compounds or mixtures, provided they are unirradiated and in solid or liquid form.

(c) Radioactive material, other than fissile material, for which the A_2 value is unlimited.

(d) Other radioactive material in which the radioactive material is distributed throughout and the estimated average specific activity does not exceed 30 times the value for exempt material activity concentration determined under Appendix O.

SECTION 6. DHS 157.03 (200) (c) and (208) are amended to read:

DHS 157.03 **(200)** (c) The estimated average specific activity of the solid, excluding any shielding material, does not exceed 2 x 10-3 A_2/g.

DHS 157.03 **(208)** "Medical event" means an ~~improper~~ administration of radiation or radioactive material to a patient or human research subject that requires reporting to the department.

SECTION 7. DHS 157.03 (215m) and (219m) are created to read:

DHS 157.03 **(215m)** "Mobile device" means a piece of equipment containing licensed radioactive material that is either mounted on wheels or casters, or otherwise equipped for moving without a need for disassembly or dismounting; or designed to be hand carried. "Mobile device" does not include stationary equipment installed in a fixed location.

DHS 157.03 **(219m)** "Movement control center" means an operations center that is remote from transport activity and that maintains position information on the movement of radioactive material, receives reports of attempted attacks or thefts, provides a means for reporting these and other problems to appropriate agencies and, requests and coordinates appropriate aid.

SECTION 8. DHS 157.03 (221m) is amended to read:

DHS 157.03 **(221m)** "Nationally tracked source" means a sealed source containing a quantity equal to or greater than category 1or category 2 ~~levels~~ thresholds of any radioactive material listed in Appendix T. In this context a sealed source is defined as radioactive material that is sealed in a capsule or closely bonded, in a solid form and which is not exempt from regulatory control. It does not mean material encapsulated solely for disposal, or nuclear material contained in any fuel assembly, subassembly, fuel rod, or fuel pellet. Category 1 nationally tracked sources are those containing radioactive material at a quantity equal to or greater than the category1 threshold. Category 2 nationally tracked sources are those containing radioactive

material at a quantity equal to or greater than the category 2 threshold but less than the category 1 threshold.

SECTION 9. DHS 157.03 (221m) (Note), (228m), (230m), (318m), (319g), (319r), (331g), (331r), (374m), (392m), (393m), and (402g) are created to read:

DHS 157.03 **(221m)** Note: Appendix T is used to determine the category 1 and category 2 thresholds for a nationally tracked source. The category 1 and category 2 thresholds in Appendix T and Appendix U are not interchangeable.

DHS 157.03 **(228m)** "No-later-than arrival time" means the date and time that the shipping licensee and receiving licensee have established as the time at which an investigation will be initiated if the shipment has not arrived at the receiving facility. The no-later-than arrival time may not be more than 6 hours after the estimated arrival time for shipments of category 2 quantities of radioactive material.

DHS 157.03 **(230m)** "Non-fixed contamination" means contamination that can be removed from a surface during normal conditions of transport.

DHS 157.03 **(318m)** "Reviewing official" means the individual who shall make the trustworthiness and reliability determination of an individual to determine whether the individual may have, or continue to have, unescorted access to the category 1 or category 2 quantities of radioactive materials that are possessed by the licensee.

DHS 157.03 **(319g)** "Sabotage" means the act of any person who intentionally damages, interferes, or tampers with reasonable grounds to believe his or her act will hinder, delay, or interfere with the normal operation of any one of the following:

(a) A category 1 or category 2 quantity of radioactive material.

(b) A device that contains a category 1 or category 2 quantity of radioactive material.

(c) The components of the security system.

DHS 157.03 **(319r)** "Safe haven" means a readily recognizable and readily accessible site at which security is present or from which, in the event of an emergency, the transport crew can notify and wait for the local law enforcement authorities.

DHS 157.03 **(331g)** "Security order" means any order that was issued by the NRC that required fingerprints and an FBI criminal history records check for access to any one of the following:

(a) Safeguards information.

(b) Safeguards information-modified handling.

(c) Risk significant material such as special nuclear material or large quantities of uranium hexafluoride.

DHS 157.03 **(331r)** "Security zone" means any temporary or permanent area established by the licensee for the physical protection of category 1 or category 2 quantities of radioactive material.

DHS 157.03 **(374m)** "Telemetric position monitoring system" means a data transfer system that captures information by instrumentation or measuring devices about the location and status of a transport vehicle or package between the departure and destination locations.

DHS 157.03 **(392m)** "Tribal official" means the highest ranking individual that represents Tribal leadership, such as the Chief, President, or Tribal Council leadership.

DHS 157.03 **(393m)** "Trustworthiness and reliability" means the characteristics of an individual considered dependable in judgment, character, and performance, such that unescorted access to category 1 or category 2 quantities of radioactive material by that individual does not constitute an unreasonable risk to the public health and safety or security. A determination of trustworthiness and reliability for this purpose is based upon the results from a background investigation.

DHS 157.03 **(402g)** "Unescorted access" means solitary access to a category 1 or category 2 quantity of radioactive material or the devices that contain the material.

SECTION 10. DHS 157.03 (404) and (419m) are amended to read:

DHS 157.03 **(404)** "Unrefined and unprocessed ore" means ore in its natural form prior to any processing, such as grinding, roasting or beneficiating, or refining the ore from its natural state. Processing does not include sieving or encapsulation of ore or preparation of samples for laboratory analysis.

DHS 157.03 **(419m)** "~~Well logging~~ Well logging assistant" means any individual who, under the personal supervision of a well logging supervisor, handles sources of radiation that are not in logging tools or shipping containers or who performs surveys required by s. DHS 157.55.

SECTION 11. DHS 157.09 (1) (a) (intro.), and (1) (a) 5. a. and b. are amended to read:

DHS 157.09 **(1)** (a) A person is exempt from ~~this subchapter~~ subch. III and X if the person receives, possesses, uses, owns or transfers any of the following types and forms of source material:

DHS 157.09 **(1)** (a) 5. a. Glazed ceramic tableware manufactured before August 27, 2013, provided that the glaze contains not more than 20% by weight source material.

DHS 157.09 **(1)** (a) 5. b. Glassware containing not more than ~~10~~2% by weight source material, or for glassware manufactured before August 27, 2013, 10% by weight source material;

but not including commercially manufactured glass brick, pane glass, ceramic tile or other glass or ceramic used in construction.

SECTION 12. DHS 157.09 (1) (a) 8. a. is repealed.

SECTION 13. DHS 157.09 (1) (a) 8. b., c., and d. are renumbered DHS 157.09 (1) (a) 8. a., b., and c.

SECTION 14. DHS 157.09 (1) (a) 10. (intro.) is amended to read:

DHS 157.09 **(1)** (a) 10. (intro.) Thorium or uranium contained in or on finished optical lenses and mirrors, provided that a lens or mirror does not contain more than ~~30~~10% by weight of thorium or uranium or for lenses manufactured before August 27, 2013, 30% by weight of thorium and that this exemption is not deemed to authorize either of the following:

SECTION 15. DHS 157.09 (1) (a) 11. and 12. are repealed and recreated to read:

DHS 157.09 **(1)** (a) 11. Thorium contained in any finished aircraft engine part containing nickel-thoria alloy, provided that the thorium is dispersed in the alloy in the form of finely divided thoria, and the thorium content in the nickel-thoria alloy does not exceed 4% by weight.

DHS 157.09 **(1)** (a) 12. Only persons authorized by a license issued under 10 CFR 40.52, may initially transfer for sale or distribution such products containing source material to a person exempt under this subsection.

SECTION 16. DHS 157.09 (1) (a) 13. is created to read:

DHS 157.09 **(1)** (a) 13. Persons authorized by an agreement state to manufacture, process, or produce materials or products containing source material, and persons who import finished products or parts for sale or distribution, shall be licensed for distribution only under 10 CFR 40.52, and are exempt from s. DHS 157.13 (2) (a) and (b), and subch. III and X.

SECTION 17. DHS 157.09 (2) (c) 7. is amended to read:

DHS 157.09 **(2)** (c) 7. Electron tubes, including spark gap tubes, power tubes, gas tubes including glow lamps, receiving tubes, microwave tubes, indicator tubes, pick-up tubes, radiation detection tubes and any other completely sealed tube that is designed to conduct or control electrical currents, provided that the radiation dose rate from each electron tube containing radioactive material does not exceed 10 ~~u~~Gy microgy (1 millirad) per hour at one centimeter from any surface when measured through 7 milligrams per square centimeter of absorber and that each tube does not contain more than one of the following specified quantities of radioactive material:

SECTION 18. DHS 157.09 (2) (c) 9., 10., and 11. are created to read:

DHS 157.09 **(2)** (c) 9. Static elimination devices which contain, as a sealed source or sources, radioactive material consisting of a total of not more than 18.5 MBq (500 microcuries) of polonium-210 per device.

DHS 157.09 **(2)** (c) 10. Ion generating tubes designed for ionization of air that contain, as a sealed source or sources, radioactive material consisting of a total of not more than 18.5 MBq (500 microcuries) of polonium-210 per device or of a total of not more than 1.85 GBq (50 mCi) of hydrogen-3 (tritium) per device.

DHS 157.09 **(2)** (c) 11. Devices authorized before October 23, 2012 for use under the general license then provided in DHS 157.11 (2) (a), equivalent regulations of the NRC, or other agreement states, and manufactured, tested, and labeled by the manufacturer in accordance with the specifications contained in a specific license issued by the NRC.

SECTION 19. DHS 157.09 (2) (d) 1. and 2., and (e) 1. are amended to read:

DHS 157.09 **(2)** (d) 1. Except for persons who manufacture, process, produce, or initially transfer for sale or distribution of self-luminous products containing tritium, krypton-85 or promethium-147, and except as provided in subd. 3., any person is exempt from this subchapter to the extent that such person receives, possesses, uses, transfers, owns or acquires tritium, krypton-85 or promethium-147 in self-luminous products manufactured, processed, produced or initially transferred under a specific license issued by the NRC according to 10 CFR 32.22, which authorizes the initial transfer of the product for use under this subdivision.

2. Any person who desires to manufacture, process, ~~or~~ produce, or initially transfer for sale or distribution self-luminous products containing tritium, krypton-85 or promethium-147, or to transfer such products for use according to subd. 1., shall apply for a license issued by the NRC according to 10 CFR 32.22, which states that the product may be transferred by the licensee to persons exempt from this subchapter according to subd. 1. or equivalent regulations of the NRC or an agreement state.

DHS 157.09 **(2)** (e) 1. Except for persons who manufacture, process, produce or initially transfer for sale or distribution gas and aerosol detectors containing radioactive material, a person is exempt from this subchapter if the person receives, possesses, uses, transfers, owns or acquires radioactive material in gas and aerosol detectors designed to protect life or property from fires and airborne hazards provided that the detectors containing radioactive material have been manufactured, processed, produced or initially transferred for sale or distribution under a specific license issued by the NRC under 10 CFR 32.26, a licensing state, other agreement state or the department under s. DHS 157.13 (4) (c), which authorizes the transfer of the detectors to persons who are exempt from regulatory requirements. This exemption also covers gas and aerosol detectors manufactured or distributed before November 30, 2007 in accordance with a specific license issued by an agreement state under comparable provisions under 10 CFR 32.26 authorizing distribution to persons exempt from regulatory requirements.

SECTION 20. DHS 157.09 (2) (e) 4. and (g) and DHS 157.09 (3) are created to read:

DHS 157.09 **(2)** (e) 4. Any person who desires to manufacture, process, or produce gas and aerosol detectors containing byproduct material, or to initially transfer such products for use according to subd. 1., shall apply for a license issued by the NRC according to 10 CFR 32.26 and certificate of registration in accordance with 10 CFR 32.210, which states that the product may be transferred by the licensee to persons exempt from this subchapter according to subd. 1. or equivalent regulations of the NRC or an agreement state.

DHS 157.09 **(2)** (g) *Industrial use devices containing exempt quantities or disturbed under a general license.* 1. Except for persons who manufacture, process, produce or initially transfer for sale or distribution of industrial devices designed and manufactured for the purpose of detecting, measuring, gauging or controlling thickness, density, level, interface location, radiation, leakage, or qualitative or quantitative chemical composition, or for producing an ionized atmosphere containing radioactive material, a person is exempt from this subchapter if the person receives, possesses, uses, transfers, owns or acquires radioactive material in these certain detecting, measuring, gauging, or controlling devices and certain devices for producing an ionized atmosphere have been manufactured, processed, produced or initially transferred for sale or distribution under a specific license issued by the NRC under 10 CFR 32.30, a licensing state, other agreement state or the department under s. DHS 157.13 (4) (c), which authorizes the transfer of the detectors to persons who are exempt from regulatory requirements. This exemption does not cover sources not incorporated into a device, such as calibration and reference sources.

2. Industrial devices previously manufactured and distributed to general licensees under the specific license issued by an agreement state shall be considered exempt under this subdivision provided that the device is labeled under the specific license authorizing distribution of the generally licensed device and provided further that they meet the requirements of s. DHS 157.13 (4) (c).

3. Any person who desires to manufacture, process, produce, or initially transfer for sale or distribution of industrial devices containing byproduct material for use according to subd. 1., shall apply for a license issued by the NRC according to 10 CFR 32.30 and certificate of registration in accordance with 10 CFR 32.210, which states that the product may be transferred by the licensee to persons exempt from this subchapter according to subd. 1. or equivalent regulations of the NRC or an agreement state.

DHS 157.09 **(3)** EXEMPTIONS OF CATEGORY 1 OR CATEGORY 2 QUANTITIES OF RADIOACTIVE WASTE**.** A licensee that possesses radioactive waste that contains category 1 or category 2 quantities of radioactive material, other than waste that contains discrete sources, ion-exchange resins, or activated material that weighs less than 2,000 kg (4,409 lbs), is exempt from the requirements of ss. DHS 157.100 to 157.122 and shall implement all the following requirements to secure the radioactive waste:

(a) Use continuous physical barriers that allow access to the radioactive waste only through established access control points.

(b) Use a locked door or gate with monitored alarm at the access control point.

(c) Assess and respond to each actual or attempted unauthorized access to determine whether an actual or attempted theft, sabotage, or diversion occurred.

(d) Immediately notify the LLEA and request an armed response from the LLEA upon determination that there was an actual or attempted theft, sabotage, or diversion of the radioactive waste that contains category 1 or category 2 quantities of radioactive material.

SECTION 21. DHS 157.10 (3) is repealed and recreated to read:

DHS 157.10 **(3)** FEE SCHEDULE. The following is the schedule of application, annual, amendment and reciprocity fees for specific radioactive material licenses.

Category	License Type	Application & Annual Fee
1.	**Special Nuclear Material**	
A.	License for possession and use of SNM in sealed sources contained in devices used in measuring systems	$1,000
B.	License for use of SNM to be used as calibration and reference sources	$300
C.	SNM – all other, except license authorizing special nuclear material in unsealed form that would constitute a critical mass [Fee waived if facility holds additional license category]	$1,500
2.	**Source Material**	
A.	Source material processing and distribution	$4,000
B.	Source material in shielding [Fee waived if facility holds additional license category]	$400
C.	Source material – all other, excluding depleted uranium used as shielding or counterweights	$3,000
3.	**Byproduct, NARM**	
A.	License of broad scope for processing or	$20,000

	manufacturing of items for commercial distribution	
B.	License for processing or manufacturing and commercial distribution of radiopharmaceuticals, generators, reagent kits and sources or devices	$12,000
C.	License for commercial distribution or redistribution of radiopharmaceuticals, generators, reagent kits and sources or devices	$3,000
D.	Other licenses for processing or manufacturing of items for commercial distribution	$4,000
E.	License for industrial radiography operations performed only in a shielded radiography installation	$3,000
F.	License for industrial radiography performed only at the address indicated on the license, and at temporary job sites	$5,000
G.	License for possession and use of less than 370 TBq (10,000 curies) of radioactive material in sealed sources for irradiation of materials where the source is not removed from the shield [Fee waived if facility holds additional irradiator license category]	$2,000
H.	License for possession and use of less than 370 TBq (10,000 curies) of radioactive material in sealed sources for	$3,000

	irradiation of materials where the source is exposed for irradiation purposes. The category also includes underwater irradiators for irradiation of materials in which the source is not exposed for irradiation	
I.	License for possession and use of at least 370 TBq (10,000 curies) and less than 3.7 PBq (100,000 curies)of radioactive material in sealed sources for irradiation of materials	$5,000
J.	License for possession and use of 3.7 PBq (100,000 curies) or more of radioactive material in sealed sources for irradiation of materials	$12,000
K.	License to distribute items containing radioactive materials to persons under a general license	$2,000
L.	License to possess radioactive materials intended for distribution to persons exempt from licensing	$2,500
M.	License of broad scope for research and development that does not authorize commercial distribution	$6,000
N.	Other licenses for research and development that do not authorize commercial distribution	$1,800
O.	License for installation, repair, maintenance leak testing or other service of devices or items containing radioactive material, or to perform	$1,800

	services for other persons, including testing of sealed sources for leakage or contamination, instrument calibration, and sample analysis,_excluding waste transportation or broker services	
P.	License for portable gauges, including industrial *Lixiscope* ®	$1,400
Q.	License for portable x−ray fluorescence analyzer calibration flood source, dewpointer or gas chromatograph	$200
R.	All other byproduct, naturally− occurring or accelerator− produced material licenses, except as otherwise noted	$2,000
4.	**Waste Processing**	
A.	Commercial waste treatment facilities, including incineration	$200,000
B.	All other commercial facilities involving waste compaction, repackaging, storage or transfer	$25,000
C.	Waste processing – all other, including decontamination service	$5,000
5.	**Well Logging**	
A.	License for well logging using sealed sources or sub−surface tracer studies	$4,000
B.	License for well logging using sealed sources and sub−surface tracer studies	$5,000
6.	**Nuclear Laundry**	
A.	License for commercial collection and laundry of items contaminated with radioactive material	$16,000
7.	**Medical/Veterinary**	
A.	License for human use of	$12,000

	byproduct, source, special nuclear or NARM material in sealed sources contained in teletherapy or stereotactic radiosurgery devices, including mobile therapy	
B.	License of broad scope for human use of byproduct, source, special nuclear or NARM materials used in medical diagnosis, treatment, research and development, excluding teletherapy, or stereotactic radiosurgery devices	$20,000
C.	License for mobile nuclear medicine	$2,500
D.	Medical – all others, including SNM pacemakers and high dose rate remote afterloading devices	$5,000
E.	License for veterinary use of radioactive materials	$2,000
8.	**Academic**	
A.	License for possession and use of byproduct, naturally–occurring or accelerator produced radioactive material for educational use or academic research and development that does not authorize commercial distribution, excluding broad scope or human use licenses, with a combined possession limit of 12 isotopes and 37 GBq (1 curie) total activity	$1,000
9.	**Accelerator**	
A.	License for accelerator production of radioisotopes with commercial distribution	$4,000

B.	Accelerator isotope production – all other [Fee waived if facility holds medical broad scope license with no commercial distribution]	$2,000
10.	**Reciprocity**	
A.	Reciprocal recognition of an out−of−state specific license	50% of annual fee of applicable category
11.	**Amendments**	
A.	Request to amend specific license − no license review	$0

Note: Examples include spelling corrections and adding or removing previously authorized users.

B.	Request to amend specific license − license review required	$200

Note: Examples include new isotopes, license termination not requiring a site visit and procedural changes.

C.	Request to amend specific license − license review and site visit required	$400

Note: Examples include a facility move, license termination requiring a site visit and new processes.

SECTION 22. DHS 157.11 (1) (a) is repealed and recreated to read:

DHS 157.11 **(1)** (a) *General license for certain organizations to use and transfer limited amounts of source material.* A general license is issued authorizing commercial and industrial firms, research, educational and medical institutions and state and local government agencies to receive, possess, use, and transfer uranium and thorium, in their natural isotopic concentrations and in the form of depleted uranium, for research, development, educational, commercial, or operational purposes.

1**.** The general license issued under this paragraph shall be limited to the following forms and quantities:

a. No more than 1.5 kg (3.3 lbs) of uranium and thorium in dispersible forms (e.g., gaseous, liquid, powder, etc.) at any one time. Any material processed by the general licensee that alters the chemical or physical form of the material containing source material shall be accounted for as a dispersible form. A person authorized to possess, use, and transfer source material under this paragraph may not receive more than a total of 7 kg (15.4 lbs) of uranium and thorium in any one calendar year.

b. No more than a total of 7 kg (15.4 lbs) of uranium and thorium at any one time. A person authorized to possess, use, and transfer source material under this paragraph may not receive more than a total of 70 kg (154 lb) of uranium and thorium in any one calendar year. A person may not alter the chemical or physical form of the source material possessed under this subsection unless it is accounted for under the limits of subd. 1. a.

c. No more than 7 kg (15.4 lbs) of uranium, removed during the treatment of drinking water, at any one time. A person may not remove more than 70 kg (154 lb) of uranium from drinking water during a calendar year under this paragraph.

d. No more than 7 kg (15.4 lbs) of uranium and thorium at laboratories for the purpose of determining the concentration of uranium and thorium contained within the material being analyzed at any one time. A person authorized to possess, use, and transfer source material under this paragraph may not receive more than a total of 70 kg (154 lbs) of source material in any one calendar year.

2. A person who receives, possesses, uses or transfers source material under the general license issued under this paragraph shall comply with all the following:

a. Not administer source material under the general license issued under this paragraph, or radiation from the source material, either externally or internally, to human beings except as authorized by the department in a specific license.

b. Not export source material under the general license issued under this paragraph except as allowed under 10 CFR Part 110.

c. Not abandon source material under the general license issued under this paragraph.

3. Source material may be disposed of by any of the following methods:

a. A cumulative total of 0.5 kg (1.1 lbs) of source material in a solid, non-dispersible form may be transferred each calendar year, by a person authorized to receive, possess, use, and transfer source material under this general license to persons receiving the material for permanent disposal. A person is exempt from the requirement to obtain a license under this subchapter if source material is transferred to the person for permanent disposal under the provisions of this paragraph, and the person is not authorized to possess source material under a specific license issued under this chapter.

b. In accordance with s. DHS 157.30 (1).

4. A person who receives, possesses, uses or transfers source material under the general license issued under this paragraph is subject to the provisions in ss. DHS 157.01 to 157.03, 157.05 (2), 157.06 (1) to (3), 157.13 (9), 157.13 (10), 157.13 (15), 157.13 (16), 157.31, 157.32, 157.89 (4) (b), and 157.90 to 157.91.

5. A person who receives, possesses, uses or transfers source material under the general license issued under this paragraph shall conduct activities so as to minimize contamination of the facility and the environment. The general licensee shall notify the department immediately if evidence of contamination is identified when activities at any site involving source materials have permanently ceased. The department may offer consultation to the general licensee regarding the appropriateness of sampling and restoration activities to ensure that contamination or residual source material remaining at the site is not likely to result in exposures that exceed the limits in s. DHS 157.33 (2).

6. A person who receives, possesses, uses or transfers source material pursuant to the specific terms of a general license issued under this paragraph, and who does not possess source material under a specific license issued under this chapter, is exempt from subchs. III and X, except that such person shall comply with ss. DHS 157.33 (2) and DHS 157.30 (1).

7. No person may initially transfer or distribute source material to persons in possession of a general license issued in par. (1) a. or b., or equivalent regulations of the NRC or another agreement state, unless authorized by a specific license issued by the department, the NRC, or another agreement state. This prohibition does not apply to analytical laboratories returning processed samples to the client who initially provided the sample.

SECTION 23. DHS 157.11 (2) (a) is amended to read:

DHS 157.11 **(2)** (a) *General license relating to certain devices and equipment*. A general license is issued to transfer, receive, acquire, own, possess and use radioactive material incorporated in all the following devices or equipment which have been manufactured, tested and labeled by the manufacturer under a specific license issued to the manufacturer by the NRC ~~for use under 10 CFR 31.3~~. This general license is exempt from the requirements of subch. III, with the exception of ss. DHS 157.30 (1), 157.32 (1) and (2), and subch. X.

SECTION 24. DHS 157.13 (1) (h) (intro.) and 1. are amended to read:

DHS 157.13 **(1)** (h) Each application to use radioactive material in the form of a sealed source or in a device that contains a sealed source shall contain ~~either~~ one of the following:

1**.** Information that identifies the source or device by manufacturer and model number as registered with the NRC under 10 CFR 32.210 or an agreement state~~.~~, or for a source or device containing radium-226 or accelerator-produced radioactive material, information that identifies the source or device by manufacturer and model number as registered with a state under provisions comparable to 10 CFR 32.210.

SECTION 25. DHS 157.13 (1) (h) 3., 4., and 5. are created to read:

DHS 157.13 **(1)** (h) 3. For sources or devices containing naturally occurring or accelerator-produced radioactive material manufactured prior to November 30, 2007 that are not registered with the NRC under 10 CFR 32.210 or with an agreement state, and for which the applicant is unable to provide all categories of information specified in 10 CFR 32.210 (c), the

applicant shall provide all available categories of information identified in 10 CFR 32.210 (c) concerning the source, and, if applicable, the device. For any unavailable categories of information specified in 10 CFR 32.210 (c), the applicant shall provide sufficient additional information to demonstrate that there is reasonable assurance that the radiation safety properties of the source or device are adequate to protect health and minimize danger to life and property. Such information shall include a description of the source or device, a description of radiation safety features, the intended use and associated operating experience, and the results of a recent leak test.

4. For sealed sources and devices allowed to be distributed without registration of safety information in accordance with 10 CFR 32.210(g)(1), the applicant may supply only the manufacturer, model number, and radionuclide and quantity.

5. If it is not feasible to identify each sealed source and device individually, the applicant may propose constraints on the number and type of sealed sources and devices to be used and the conditions under which they will be used, in lieu of identifying each sealed source and device.

SECTION 26. DHS 157.13 (1) (i) is amended to read:

DHS 157.13 **(1)** (i) Each application for a specific license, other than a renewal, shall contain information describing how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning and minimize, to the extent practicable, the generation of radioactive waste. Licensees shall, to the extent practical, conduct operations to minimize the introduction of residual radioactivity into the site, including the subsurface, in accordance with the existing radiation protection requirements in s. DHS 157.21 and the radiological criteria for license termination in s. DHS 157.33.

SECTION 27. DHS 157.13 (4) (d) 1. h. is created to read:

DHS 157.13 **(4)** (d) 1. h. Each device has been registered in the Sealed Source and Device Registry.

SECTION 28. DHS 157.13 (4) (e), (f) and (h) 2. are amended to read:

DHS 157.13 **(4)** (e) *Special requirements for the manufacture, assembly or repair of luminous safety devices for use in aircraft*. The department shall approve an application for a specific license to manufacture, assemble or repair luminous safety devices containing tritium or promethium-147 for use in aircraft, for distribution to persons generally licensed under s. DHS 157.11 (2) (c) if the applicant satisfies the general requirements specified in sub. (2) and the requirements of 10 CFR 32.53 to 32.56, ~~32.101 and 32.110~~ or their equivalent.

(f) *Special requirements for license to manufacture calibration or reference sources containing americium-241, plutonium or radium-226 for distribution to persons generally licensed under s. DHS 157.11 (2) (e).* The department shall approve an application for a specific license to manufacture calibration or reference sources containing americium-241, plutonium or

radium-226 to persons generally licensed under s. DHS 157.11 (2) (e) if the applicant satisfies the general requirement of sub. (2) and the requirements of 10 CFR 32.57 to 32.59~~, 10 CFR 32.102~~ and 10 CFR 70.39 or their equivalent.

DHS 157.13 **(4)** (h) 2. The criteria of 10 CFR 32.61~~,~~ and 32.62~~, 32.103 and 32.110~~ are met.

SECTION 29. DHS 157.13 (4) (j) 5. is created to read:

DHS 157.13 **(4)** (j) 5. The source or device has been registered in the sealed source and device registry.

SECTION 30. DHS 157.13 (4m) is created to read:

DHS 157.13 **(4m)** SPECIAL REQUIREMENTS FOR A SPECIFIC LICENSE TO INITIALLY TRANSFER SOURCE MATERIAL TO A PERSON

(a) The department shall approve an application for a specific license to initially transfer source material if all the following conditions are satisfied:

1. The applicant satisfies the general requirements in s. DHS 157.13 (2).

2. The applicant submits adequate information on, and the department approves the methods to be used for quality control, labeling, and providing safety instructions to recipients, based upon adequate information submitted by the applicant.

(b) Each person licensed under par. (a) shall label the immediate container of each quantity of source material with the type of source material and quantity of material and the words, "radioactive material."

(c) Each person licensed under par. (a) shall ensure that the quantities and concentrations of source material are as labeled and indicated in any transfer records.

(d) Each person licensed under par. (a) shall provide all of the following information to each person to whom source material is transferred for use under s. DHS 157.11 (1), or equivalent regulations of the NRC or another agreement state, before the source material is transferred to the person for the first time in each calendar year:

1. A copy of ss. DHS 157.11 (1) and 157.13 (4m) or relevant equivalent regulations of the NRC or another agreement state.

2. Appropriate radiation safety precautions and instructions relating to handling, use, storage, and disposal of the source material.

(e) Each person licensed under s. 157.13 (4m) a. shall report transfers as follows:

1. File a report with the department for each general licensee under s. DHS 157.11(1) or equivalent NRC or another agreement state provisions to whom greater than 50 grams (0.11 lbs) of source material has been transferred in a single calendar quarter. The report shall include the following information:

a. The name, address, and license number of the person who transferred the source material.

b. The name and address of the general licensee to whom source material is distributed; a responsible agent, by name and/or position and phone number, of the general licensee to whom the material was sent; and the type, physical form, and quantity of source material transferred.

c. The total quantity of each type and physical form of source material transferred in the reporting period to all such generally licensed recipients.

2. For material shipped to another state, file a report with each applicable responsible state agency or the NRC that identifies all persons, operating under provisions equivalent to s. DHS 157.11(1), to whom greater than 50 grams (0.11 lbs) of source material has been transferred within a single calendar quarter. The report shall include the following information specific to those transfers made to the applicable responsible state agency, or NRC, being reported to:

a. The name, address, and license number of the person who transferred the source material.

b. The name and address of the general licensee to whom source material was distributed; a responsible agent, by name and/or position and phone number, of the general licensee to whom the material was sent; and the type, physical form, and quantity of source material transferred.

c. The total quantity of each type and physical form of source material transferred in the reporting period to all such generally licensed recipients.

3. Submit each report by January 31 of each year covering all transfers for the previous calendar year. If no transfers were made to persons generally licensed s. DHS 157.11(1) or equivalent NRC or another agreement state provision during the current period, a report shall be submitted to the department and applicable responsible state agency or the NRC. If no transfers have been made to general licensees in a particular state during the reporting period, this information shall be reported to the responsible state agency or the NRC upon request.

(f) Each person licensed under par. (a) shall maintain all information that supports the reports required by this subsection concerning each transfer to a general licensee for a period of one year after the event is included in a report.

SECTION 31. DHS 157.13 (10) (b) is renumbered DHS 157.13 (10 (b) 1.

SECTION 32. DHS 157.13 (10) (b) 2. is created to read:

DHS 157.13 **(10)** (b) 2. An application for transfer of license shall include all the following:

a. The identity, technical and financial qualifications of the proposed transferee.

b. Financial assurance for decommissioning information, as applicable, required by s. DHS 157.15.

SECTION 33. DHS 157.13 (10) (e) 2. is amended to read:

DHS 157.13 **(10)** (e) 2. An entity defined in 11 USC 101(~~14~~15) controlling the licensee or listing the license or licensee as property of the estate.

SECTION 34. DHS 157.15 (1) (a) 2. and 4., (5) (a) (intro.) and 1. are amended to read:

DHS 157.15 **(1)** (a) 2. Unsealed radioactive material with a half-life greater than 120 days involving a combination of isotopes with R divided by 10^5 being greater than one, where R is defined as the sum of the ratios of the quantity of each isotope to the applicable value in Appendix I.

DHS 157.15 **(1)** (a) 4. Sealed sources or plated foils with a half-life greater than 120 days involving a combination of isotopes with R divided by 10^{12} being greater than one, where R is defined as the sum of the ratios of the quantity of each isotope to the applicable value in Appendix I.

DHS 157.15 **(5)** DECOMMISSIONING FUNDING PLAN. (a) A decommissioning funding plan shall be submitted to the department for review and approval and shall include all the following information:

DHS 157.15 **(5)** (a) 1**.** A detailed cost estimate for decommissioning ~~that considers~~ in an amount reflecting all of the following:

SECTION 35. DHS 157.15 (5) (a) 1. e. and f. are created to read:

DHS 157.15 **(5)** (a) 1. e. The volume of onsite subsurface material containing residual radioactivity that will require remediation to meet the criteria for license termination.

DHS 157.15 **(5)** (a) 1. f. The cost of an independent contractor to perform all decommissioning activities including an adequate contingency factor.

SECTION 36. DHS 157.15 (5) (a) 2. is repealed and recreated to read:

DHS 157.15 **(5)** (a) 2. Identification of and justification for using the key assumptions contained in the decommissioning cost estimate.

SECTION 37. DHS 157.15 (5) (a) 3. and (5) (b) are amended to read:

DHS 157.15 **(5)** (a) 3. A description of the method ~~for adjusting cost estimates and associated funding levels periodically over the life of the facility. Cost estimates shall be adjusted at intervals not to exceed 3 years.~~ for assuring funds for decommissioning according to sub. (6), including means for adjusting cost estimates and associated funding levels periodically over the life of the facility. ~~Cost estimates shall be adjusted at intervals not to exceed 3 years.~~

DHS 157.15 **(5)** (b) The decommissioning funding plan shall also contain the licensee's certification that financial assurance has been provided in the amount of the cost estimate for decommissioning and that a signed original of the financial instrument obtained to satisfy the requirements of sub. (6) has been submitted and accepted, unless a previously submitted and accepted financial instrument continues to cover the cost estimate for decommissioning.

SECTION 38. DHS 157.15 (5) (c) is created to read:

DHS 157.15 **(5)** (c) At intervals not to exceed 3 years, the licensee shall resubmit the decommissioning funding plan to the department with adjustments as necessary to account for changes in costs and extent of contamination. The amount of financial assurance shall not be decreased until the updated decommissioning funding plan is approved. The licensee shall update the information submitted with the original or previously approved decommissioning funding plan, and shall specifically consider the effect of all the following events on decommissioning costs:

1. Spills of radioactive material producing additional residual radioactivity in onsite subsurface material.

2. Waste inventory increasing above the amount estimated.

3. Waste disposal costs increasing above the amount previously estimated.

4. Facility modifications.

5. Changes in authorized possession limits.

6. Actual remediation costs that exceed the previous cost estimate.

7. Onsite disposal.

8. Use of a settling pond.

SECTION 39. DHS 157.21 (1) is amended to read:

DHS 157.21 **(1)** A licensee or registrant shall develop, document and implement a radiation protection program sufficient to ensure compliance with the provisions of this

subchapter. A licensee or registrant shall designate a person in control over each radiation installation.

SECTION 40. DHS 157.22 (1) (e) (Note), (4) (h) 2., and (5) (d) 1. and (Note) are amended to read:

DHS 157.22 (1) (e) Note: See footnote ~~e/~~c/ of Appendix E for the calculation method for determining DAC for ~~soluable~~ soluble mixtures of uranium.

DHS 157.22 **(4)** (h) 2. For an ALI and the associated DAC determined by the ~~nonstochastic~~ non-stochastic organ dose limit of 0.5 Sv (50 rem), the intake of radionuclides that would result in a committed effective dose equivalent of 0.05 Sv (5 rem), that is, the stochastic ALI, is listed in parentheses in Table I of Appendix E. The licensee or registrant may, as a simplifying assumption, use the stochastic ALI to determine committed effective dose equivalent. However, if the licensee or registrant uses the stochastic ALI, the licensee or registrant shall also demonstrate that the limit in s. DHS 157.22 (1) (a) 1. b. is met.

DHS 157.22 **(5)** (d) 1. A licensee or registrant shall record the exposure history, as required by par. (a), on ~~a~~ an occupational radiation exposure form provided by the department, or other clear and legible record of all the information required on that form. The form or record shall show each period in which the individual received occupational exposure to radiation or radioactive material and shall be signed by the individual who received the exposure. For each period for which a licensee or registrant obtains reports, a licensee or registrant shall use the dose shown in the report in preparing the occupational radiation exposure form or equivalent. For any period in which a licensee or registrant does not obtain a report, a licensee or registrant shall place a notation on the occupational radiation exposure form or equivalent indicating the periods of time for which data are not available.

Note: An occupational radiation exposure history form may be obtained by writing to: Department of Health Services, Radiation Protection Section, P.O. Box 2659, Madison WI 53701-2659; or by downloading the form from the Department website at: ~~http://dhs.wisconsin.gov/dph_beh/RadiationP/Index.htm~~ http://dhs.wisconsin.gov/radiation/Index.htm.

SECTION 41. DHS 157.24 (1) (b) (intro.) is amended to read:

DHS 157.24 **(1)** (b) ~~Notwithstanding the provisions of par. (a), sources~~ Each source meeting the criteria under par. (a) not in use and identified as being in storage shall meet all the following conditions:

SECTION 42. DHS 157.25 (1) (a) 1., 2. (intro.), (1) (a) 2. b. and c. are amended to read:

DHS 157.25 **(1)** (a) 1. Surveys of areas, including the subsurface, necessary for the licensee or registrant to comply with this subchapter.

DHS 157.25 **(1)** (a) 2. Surveys of areas, including the subsurface, necessary and reasonable under the circumstances to evaluate any of the following:

DHS 157.25 **(1)** (a) 2. b. Concentrations or quantities of ~~radioactive material~~ residual radioactivity.

DHS 157.25 **(1)** (a) 2. c. The potential radiological hazards of the radiation levels detected and residual radioactivity detected.

SECTION 43. DHS 157.25 (1) (d) is created to read:

DHS 157.25 **(1)** (d) Notwithstanding s. DHS 157.31 (3) (a), records from surveys describing the location and amount of subsurface residual radioactivity identified at the site shall be kept with decommissioning records and shall be retained under s. DHS 157.15.

SECTION 44. DHS 157.25 (2) (a) 5. is amended to read:

DHS 157.25 **(2)** (a) 5. An individual operating medical fluoroscopic equipment.

SECTION 45. DHS 157.33 (3) (a) 4. is created to read**:**

DHS 157.33 **(3)** (a) 4. Has provided sufficient financial assurance in the form of a trust fund to enable an independent third party, including a governmental custodian of a site, to assume and carry out responsibilities for any necessary control and maintenance of the site.

SECTION 46. DHS 157.36 (1) (a) (Note) is amended to read:

Note: The publication ANSI N432-1980 "Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography" published by the ANSI, may be consulted at the Department of Health Services, Radiation Protection Section, 1 West Wilson St, Room 150, Madison WI 53702-0007 or at the Legislative Reference Bureau. This publication may be purchased from the American National Standards Institute, Inc., 25 West 43rd Street, New York, New York 10036; Telephone: (212) 642–4900.

SECTION 47. DHS 157.43 (2) (intro.) and DHS 157.43 (2) (a) are renumbered DHS 157.43 (2) (a) and DHS 157.43 (2) (b).

SECTION 48. DHS 157.43 (2) (b) is repealed.

SECTION 49. DHS 157.44 (6) (a) 4. is amended to read:

DHS 157.44 **(6)** (a) 4. After replacement, each personnel dosimeter shall be processed according to NVLAP approved procedures, or shall be returned to the supplier for processing within 14 calendar days of the end of the monitoring period or as soon as practicable. In circumstances that make it impossible to return each personnel dosimeter within 14 calendar days, the circumstances shall be documented and available for review by the department.

SECTION 50. DHS 157.61 (7) (a) 2. b., (8) (a) 1. b., and (10) (a) and (c) are amended to read:

DHS 157.61 **(7)** (a) 2. b. Two years of full-time practical training and/or supervised experience in medical physics either under the supervision of a medical physicist who is certified in medical physics by a specialty board recognized by the department, the NRC, or another agreement state or in clinical nuclear medicine facilities providing diagnostic and/or therapeutic services under the direction of physicians who meet the requirements for authorized users in s. DHS 157.61 (10), 157.63 (5) or 157.64 (4).

DHS 157.61 **(8)** (a) 1. b. Attained two years full-time practical training and/or supervised experience in medical physics under the supervision of a medical physicist who is certified in medical physics by a specialty board recognized by the department, the NRC or an agreement state or in clinical radiation facilities providing high-energy, external beam therapy (photons and electrons with energies greater than or equal to 1 million electron volts) and brachytherapy services under the direction of physicians who meet the requirements for authorized users in s. DHS 157.61 (10), 157.65 (8) or ~~s. DHS~~ 157.67 (17).

DHS 157.61 **(10)** (a) An individual identified as a radiation safety officer, a teletherapy or ~~authorized~~ medical physicist, or a nuclear pharmacist on a department, NRC or another agreement state license, the permit issued by a licensee of broad scope or the permit issued by an NRC master material licensee before October 24, 2002 need not comply with the training requirements of subs. (7) to (9), respectively.

DHS 157.61 **(10)** (c) A physician, dentist or podiatrist identified as an authorized user for the medical, dental or podiatric use of radioactive material on a department, NRC or another agreement state license, the permit issued by a licensee of broad scope or the permit issued by an NRC master material licensee before October 24, 2002 who performs only those medical uses for which they are authorized need not comply with the training requirements of ss. DHS 157.63 to 157.67.

SECTION 51. DHS 157.61 (10) (d) is created to read:

DHS 157.61 **(10)** (d) Individuals who are not required to comply with the training requirements as described in this section may serve as preceptors for, and supervisors of, applicants seeking authorization on department licenses for the same uses for which these individuals are authorized.

SECTION 52. DHS 157.63 (2) (b) 3. and (4) (c) 2. are amended to read:

DHS 157.63 **(2)** (b) 3. An individual under the supervision, as specified in s. DHS 157.61 (~~10~~3), of the authorized nuclear pharmacist in subd.1., or the physician in subd. 2.

DHS 157.63 **(4)** (c) 2. Work experience, under the supervision of an authorized user who meets the requirements in this subsection, sub. (4) or (5), s. DHS 157.61 (10)~~,~~ or 157.64 (4), or equivalent agreement state requirements, involving all the following:

SECTION 53. DHS 157.67 (11) (f) and (12) (b) 3. are amended to read:

DHS 157.67 **(11)** (f) A licensee shall have an authorized medical physicist review the results of each spot-check within 15 working days of the spot check. The authorized medical physicist shall notify the licensee as soon as possible in writing of the results of each spot-check ~~within 10 working days~~.

DHS 157.67 **(12)** (b) 3. The authorized medical physicist shall notify the licensee as soon as possible in writing of the results of the spot check ~~review within 10 working days~~.

SECTION 54. DHS 157.71 (8) is amended to read:

DHS 157.71 **(8)** RECORDS OF DOSAGES OF UNSEALED RADIOACTIVE MATERIAL FOR MEDICAL USE. A licensee shall maintain a record of dosage determinations required by s. DHS 157.62 (3) for 3 years. The record shall contain the radiopharmaceutical, patient's or human research subject's name or identification number if one has been assigned, the prescribed dosage, the determined dosage or a notation that the total activity is less than 1.1 MBq (30 ~~mCi~~ microcuries), the date and time of the dosage determination and the name of the individual who determined the dosage.

SECTION 55. DHS 157.72 (1) (a) 1. is amended to read:

DHS 157.72 **(1)** (a) 1**.** A dose that differs from the prescribed dose or dose that would have resulted from the prescribed dosage by more than 0.05 Sv (5 rem) effective dose equivalent, 0.5 Sv (50 rem) to an organ or tissue or 0.5 Sv (50 rem) shallow dose equivalent to the skin and to which any of the following apply:

SECTION 56. DHS 157.74 (2) (b) 2., (d) 3., (f), and (h) 1. and 4. c. are amended to read:

DHS 157.74 **(2)** (b) 2. Type and size of the ~~film~~ image receptor or film-screen combination to be used.

DHS 157.74 **(2)** (d) 3.Operators of c-arm configuration units which do not operate at a tube current in excess of 0.2 mA are exempt from the requirement to wear a leaded apron, provided the operator wears a ~~personnel~~ personal dosimeter as required under s. DHS 157.25 (2).

DHS 157.74 **(2)** (f) Persons may not be exposed to the useful beam except for healing arts purposes and unless such exposure has been authorized by a licensed practitioner of the healing arts or a Wisconsin licensed physical therapist. Deliberate exposure for any of the following purposes is prohibited:

DHS 157.74 **(2)** (h) 1.The speed of the ~~screen and film combinations~~ image receptor used shall be of a speed consistent with the diagnostic objective of the examinations. Film cassettes without intensifying screens may not be used for any routine diagnostic radiological imaging, with the exception of veterinary radiography and standard film packets for intra-oral use in dental radiography.

DHS 157.74 **(2)** (h) 4. c. ~~Antiscatter~~ Anti-scatter grids or an appropriate air gap technique to reduce scatter to the image receptor shall be used for all x-ray examinations of the human torso utilizing stationary x-ray equipment for patients 12 years of age or older.

SECTION 57. DHS 157.74 (2) (m) is created to read:

DHS 157.74 **(2)** (m) Each individual operating x-ray equipment for diagnostic medical purposes on humans shall have a current radiography license or limited x-ray machine operators permit from the State of Wisconsin.

SECTION 58. DHS 157.74 (3) (b) 2. and (4) (b) are amended to read:

DHS 157.74 **(3)** (b) 2. Quality control and maintenance procedures shall be performed on a regular schedule according to the device manufacturer's recommendations or procedures approved by the department. If analysis shows that the system test results fall outside the device manufacturer's recommended limits corrective action shall be taken prior to performing patient examinations.

DHS 157.74 **(4)** (b) The darkroom shall be light tight with proper safelights so that any film type in use exposed in a cassette to x-radiation sufficient to produce an optical density from ~~one to 2~~ 1 to 2 when processed may not suffer an increase in density greater than 0.1, or 0.05 for mammography, when exposed in the darkroom for 2 minutes with all safelights on. This test shall be performed at least once every 6 months. If used, daylight film handling boxes shall preclude fogging of the film. Darkrooms typically used by more than one person shall be provided a method to prevent accidental entry while undeveloped films are being handled or processed.

SECTION 59. DHS 157.76 (7) (c) is repealed and recreated to read:

DHS 157.76 **(7)** (c) For x-ray controls manufactured on or after June 10, 2006, all of the following shall be provided for each fluoroscopic tube:

1. A display of the fluoroscopic irradiation time at the fluoroscopist's working position.

2. The display required in subd. 1. shall function independently of the audible signal described in sub. (7) (a) and meet all the following requirements:

a. When the x-ray tube is activated, the fluoroscopic irradiation time in minutes and tenths of minutes shall be continuously displayed and updated at least once every 6 seconds.

b. The fluoroscopic irradiation time shall also be displayed within 6 seconds of termination of an exposure and remain displayed until reset.

c. Means shall be provided to reset the display to zero prior to the beginning of a new examination or procedure.

3. A signal audible to the fluoroscopist shall sound for each passage of 5 minutes of fluoroscopic irradiation time during an examination or procedure. The signal shall sound until manually reset or, if automatically reset, for at least 2 seconds.

SECTION 60. DHS 157.76 (7) (d) is created to read:

DHS 157.76 **(7)** (d) If fluoroscopic equipment is modified in accordance with 21 CFR 1020.30(q) to comply with the requirements in par. (a), it shall bear a label that states:

Modified to comply with 21 CFR 1020.32(h)(2)

SECTION 61. DHS 157.76 (11) (a) is amended to read:

DHS 157.76 **(11)** (a) The ~~facility~~ registrant shall ensure that only a licensed practitioner or a radiologic technologist who is trained in the safe use of fluoroscopic x-ray systems is allowed to operate these systems. All fluoroscopic x-ray images shall be viewed, directly or indirectly, and interpreted by a licensed practitioner.

SECTION 62. DHS 157.77 (2) (h) 1., and (i) are amended to read:

DHS 157.77 **(2)** (h) 1. Stationary x-ray systems shall be required to have the x-ray control permanently mounted ~~in a protected area~~ behind a protective barrier such that the operator is required to remain ~~in that protected area~~ behind the protective barrier during the entire exposure.

DHS 157.77 **(2)** (i) *Operator protection for veterinary systems.* All stationary, mobile or portable x-ray systems used for veterinary work shall be provided with either a 2 meter (6.5 feet) high protective barrier for operator protection during exposures or a means to allow the operator to be at least 2 meters (6.5 feet) from the tube housing assembly during exposures. Persons within 2.7 meters (9 feet) of the tube or animal during exposures shall be protected with at least 0.25mm lead aprons. Persons restraining the animal during radiography shall be protected with at least ~~0.5 mm~~ 0.25mm lead aprons and full coverage gloves or full coverage mittens containing not less than 0.5mm lead equivalent material. The exposure control may be foot operated.

SECTION 63. DHS 157.78 (4) (d) 1. and 3., (8) (title), and (9) (a) are amended to read:

DHS 157.78 **(4)** (d) 1. A stationary x-ray system shall have an x-ray exposure control that ~~may be moved to a protected area so that the operator is required to remain in that protected area~~ is operable from behind a protective barrier during the entire exposure. The exposure control cord shall be of sufficient length to allow the operator to be at least 2 meters (6.5 feet) from the x-ray tube head and not in the direction of the ~~tube~~ primary beam ~~is pointed~~. The operator shall be able to determine when the exposure has completed either by audible tone or ~~by~~ visible signal.

DHS 157.78 **(4)** (d) 3. A mobile or portable x-ray system that is used for less than one week in the same location shall be provided with either a protective barrier at least 2 meters (6.5

feet) high for operator protection or means to allow the operator to be at least 2 meters (6.5 feet) from the tube housing assembly ~~while making~~ during exposures.

DHS 157.78 **(8)** ~~KVP~~ KVP LIMITATIONS.

DHS 157.78 **(9)** (a) Intraoral ~~film holding~~ image receptor devices shall be used.

SECTION 64. DHS 157.78 (10) is created to read:

DHS 157.78 **(10)** HAND-HELD INTRAORAL DENTAL RADIOGRAPHIC UNITS. A dental radiographic unit that is designed to be operated as a hand-held unit shall meet all the following requirements:

(a) For all uses:

1. Operators of hand-held intraoral dental radiographic units shall be trained to operate such equipment. The training shall cover: manufacturer specific exposure control, use of safety devices, operator and patient protection, and quality control testing.

2. When operating a hand-held intraoral dental radiographic unit, operators shall wear a lead apron and thyroid collar unless the hand-held intraoral device has a secondary protective barrier.

3. A hand-held intraoral dental radiographic unit shall be immobilized during a patient examination. A tube stand may be utilized to immobilize a hand-held intraoral dental radiographic unit during patient examination.

4. The operator shall ensure there are no bystanders within a radius of at least 2 meters (6.5 ft) from the patient being examined during exposures.

(b) For permanent facilities:

1. Hand-held intraoral dental radiographic units shall be used for patient examinations in dental offices that meet the structural shielding requirements specified by the department.

2. Hand-held intraoral dental radiographic units may not be used for patient examinations in hallways and waiting rooms.

SECTION 65. DHS 157.79 (3) (c) is amended to read:

DHS 157.79 **(3)** (c) Any person holding or supporting an animal or the ~~film~~ image receptor during radiation exposure shall wear protective gloves that surround the hand and a protective apron having a lead equivalent of not less than ~~0.5~~ 0.25 millimeter. Devices that only partially shield the hands are prohibited

SECTION 66. DHS 157.80 (1) (b) (intro.) is amended to read:

DHS 157.80 **(1)** (b) *Tomographic plane indication and alignment*. ~~A computed tomography x-ray system shall meet all of the following plane indication and alignment requirements, as applicable:~~

SECTION 67. DHS 157.80 (1) (f) 5. and 6**.** are created to read:

DHS 157.80 **(1)** (f) 5. Two-way aural communication shall exist between the patient and the operator at the control panel.

6. A viewing window, or viewing system, such as closed circuit television or an equivalent, shall be installed to permit continuous observation of the patient during irradiation. The window or viewing system shall be installed such that the operator, located at the control position, can continuously observe the patient during irradiation. When the primary viewing system is electronic, an alternative system shall be available for use in the event of failure of the primary viewing system.

SECTION 68. DHS 157.80 (2) (a)1., (b) 4., and (c) are amended to read:

DHS 157.80 **(2)** (a) 1. A CT x-ray system for human use may only be operated for diagnostic procedures by an American registry of radiologic technologists certified person who is licensed as a radiographer by the State of Wisconsin or has met the radiographer license exemptions) and has been specifically trained in its operation.

DHS 157.80 **(2)** (b) 4. A current technique chart or list of protocols available at the control panel, which specifies for each routine examination the CT conditions of operation and the number of scans per examination including body part size and correct kV/mA for that body part. The technique chart or a list of protocols shall be used to adjust techniques based on the body part being examined.

DHS 157.80 **(2)** (c) Calibration and spot check measurements shall be made at a frequency recommended by the manufacturer or established by a medical physicist. If the calibration or spot check of the CT x-ray system identifies that a system operating parameter has exceeded a tolerance established by the medical physicist, use of the CT x-ray system on patients shall be limited to those uses permitted by established written instructions of the medical physicist.

SECTION 69. DHS 157.83 (3) (b) 1. is amended to read:

DHS 157.83 **(3)** (b) 1. Notify ~~their department head no later than the next calendar day~~ the department by telephone or in person no later than 3 working days after discovery of the medical event.

SECTION 70. DHS 157.83 (3) (b) 2. a. is renumbered DHS 157.83 (3) (b) 2. and as renumbered is amended to read:

DHS 157.83 **(3)** (b) 2. Submit a written report to the department within 15 working days after discovery of the medical event. The written report shall include: the registrant's name; the prescribing physician's name; a brief description of the event; the effect on the patient; what improvements are needed to prevent recurrence; actions taken to prevent recurrence; whether the registrant notified the patient or the patient's responsible relative or guardian and if not, why not; and if the patient was notified, what information was provided to the patient. This report may not include the patient's name or other information that could lead to identification of the patient.

SECTION 71. DHS 157.83 (3) (b) 2. b. is repealed.

SECTION 72. DHS 157.83 (3) (b) 4. d. is amended to read:

DHS 157.83 **(3)** (b) 4. d. What improvements ~~are needed~~ were identified and actions taken to prevent recurrence ~~and the actions taken to prevent recurrence~~.

SECTION 73. DHS 157.84 (1) (b) 5. is created to read:

DHS 157.84 **(1)** (b) 5. Replacing the therapeutic radiation machine in an existing treatment room.

SECTION 74. DHS 157.85 (3) (title) and (13) (em) 2. through 7. are amended to read:

DHS 157.85 **(3)** ADJUSTABLE OR ~~REMOVEABLE~~ REMOVABLE BEAM-LIMITING DEVICES.

DHS 157.85 **(13)** (em) 2. Proper operation of back-up exposure control devices. External testing protocol is acceptable as long as the back-up exposure control is tested per the manufacturer's scheduled calibration cycle.

3. The output within ~~2%~~ the manufacturer's specified tolerance of the expected value, if applicable, or ~~determination of~~ the calculated output if there is no expected value.

4. Evaluation that the relative dose distribution about the source is within ~~5%~~ the manufacturer's specified tolerance of the expected value.

5. ~~Source~~ For electronic brachytherapy systems where the source is moveable, the source position accuracy ~~to~~ shall be within 1 millimeter within the applicator. Fixed x-ray source systems shall meet the manufacturer's tolerances for source location and shape within the applicator.

6. ~~Determination~~ For systems with transfer tubes and applicators, determination of the proper length of source transfer tubes and applicators.

7. ~~Determination~~ For systems with transfer tubes and applicators, determination of the operability of the source transfer tubes, applicators and transfer tube-applicator interfaces.

SECTION 75. DHS 157.85 (14) (gm) (intro.) is amended to read:

DHS 157.85 **(14)** (gm) Daily quality control checks for adjustable source electronic brachytherapy shall include all the following:

SECTION 76. DHS 157.85 (14) (gr) is created to read:

DHS 157.85 **(14)** (gr) Daily quality control checks for fixed source electronic brachytherapy shall include all the following:

1. The probe shall be checked and adjusted for mechanical straightness to be less than or equal to 0.02 cm deflection.

2. After the mechanical straightness of the probe is adjusted or checked, the beam itself shall be dynamically adjusted to be straight within the probe. This will center the beam to within 0.07mm upon the target.

3. The beam shall be checked and adjusted for isotropy to within 12%.

4. The dose output shall be checked with an ion chamber and compared to the manufacturer's dose value.

5. If dose output exceeds ± 5% of manufacturer's dose value, the physicist shall investigate why; if the output exceeds ± 10% of manufacturer's value the treatment shall not occur until the unit is brought within the manufacturer's tolerance of 5%.

SECTION 77. DHS 157.85 (16) (g) 7. d**.** is amended to read:

DHS 157.85 **(16)** (g) 7. d. A medical physicist ~~and~~, oncologist, or operator shall be ~~physically~~ present ~~during the initiation~~ and at the controls throughout the course of ~~patient~~ the patient's treatment. A medical physicist and oncologist shall remain available during treatment.

SECTION 78. DHS 157.87 (1) (intro.) is amended to read:

DHS 157.87 **(1)** GENERAL REQUIREMENTS. For certified cabinet x-ray systems including those designed to allow admittance of individuals, x-ray devices not designated as industrial radiography, and x-ray devices not used for medical imaging or therapy, all of the following requirements apply:

SECTION 79. DHS 157.87 (1) (a) is repealed and recreated to read:

DHS 157.87 **(1)** (a) Registrants and operators shall have documented training in the proper use of the system or device from one of the following:

1. The system or device manufacturer.

2. In-house staff previously trained by the system or device manufacturer.

SECTION 80. DHS 157.87 (1) (ag) and (ar) are created to read:

DHS 157.87 **(1)** (ag) The training required in par. (a) shall include all the following:

1. Basic radiation protection.

2. Operating procedures specific to system or device, including the use of various functions, safety, and maintenance.

3. Emergency procedures applicable to the system or device.

(ar) During the operation of any x-ray system or device, the operator shall ensure that ancillary personnel, members of the general public and themselves are protected from the radiation.

SECTION 81. DHS 157.87 (3) (b) 6. and (4) (a) are amended to read:

DHS 157.87 **(3)** (b) 6. Whenever personnel monitoring devices show an increase of 50% over the previous monitoring period or the readings are approaching the limits of sub. (2) (g) or (h). Radiation survey measurements are not ~~be~~ required if a person in control demonstrates compliance with par. (a) in some other manner.

DHS 157.87 **(4)** (a) *Procedures.* Operating procedures shall be written and available to all analytical x-ray equipment workers. No individual may operate analytical x-ray equipment in any manner other than that specified in the procedures unless the individual has obtained written approval of the safety office or the responsible person identified on the registration ~~in control~~.

SECTION 82. DHS 157.87 (4) (c), (d), and (e) are created to read:

DHS 157.87 **(4)** (c) *Training.* Operators of x-ray devices not designated for industrial radiography and not used for medical imaging or therapy shall have documented training in the proper use of the device from one of the following:

1. The device manufacturer.

2. In-house staff previously trained by the device manufacturer.

(d) *Training Requirements.* The training required under par. (c) shall include all the following:

1. Basic radiation protection.

2. Operating procedures specific to the device, including the use of various system functions, safety, and maintenance.

3. Emergency procedures applicable to the device.

(e) *Area Control.* During the operation of any x-ray system, the operator shall ensure that ancillary personnel, members of the general public and the operator are protected from the radiation.

SECTION 83. DHS 157.92 (2) (b) 1. and 2. are amended to read:

DHS 157.92 (2) (b) 1. Naturally occurring radioactive material and ores that are either in their natural state or have only been processed for purposes other than the extraction of the radionuclides, and that are not intended to be processed for use of these radionuclides, provided the activity concentration of the material does not exceed 10 times the values specified in Appendix O, Table VII or Table VIII.

2. Materials for which the activity concentration is not greater than the activity concentration values specified in Appendix O, Table VII or Table VIII, or for which the consignment activity is not greater than the limit for an exempt consignment found in Appendix O, Table VII or Table VIII.

SECTION 84. DHS 157.92 (2) (b) 3. is created to read:

DHS 157.92 **(2)** (b) 3. Non-radioactive solid objects with radioactive substances present on any surfaces in quantities not in excess of the levels in the definition of contamination.

SECTION 85. DHS 157.92 (2) (c) 4. is amended to read:

DHS 157.92 **(2)** (c) 4. Uranium enriched in uranium-235 to a maximum of one percent by weight, and with total plutonium and uranium-233 content of up to one percent of the mass of uranium-235, provided that the mass of any beryllium, graphite, and hydrogenous material enriched in deuterium present in the package is less than 5% of the uranium mass, and that the fissile material is distributed homogeneously and does not form a lattice arrangement within the package.

SECTION 86. DHS 157.93 (4) (am) is created to read:

DHS 157.93 **(4)** (am) The general license issued in par. (a) applies only to a licensee who has a quality assurance program approved by the commission as satisfying the provision of subpart H of 10 CFR 71.

SECTION 87. DHS 157.93 (4) (b) is repealed and recreated to read:

DHS 157.93 **(4)** (b) The licensee issued a general license in par. (a) shall meet the following:

1. Maintain a copy of the specific license, certificate of compliance, or other approval by the Nuclear Regulatory Commission of the package and ~~has~~ the drawings and other documents

referenced in the approval relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment.

2. Comply with the terms and conditions of the license, certificate, or other approval by the Nuclear Regulatory Commission, as applicable, and the applicable requirements of ch. DHS 157 and subpart A, G, and H of 10 CFR 71.

3. Prior to the licensee's first use of the package, submits in writing to the Nuclear Regulatory Commission the licensee's name and license number and the package identification number specified in the package approval. A licensee shall submit this information in accordance with 10 CFR 71.1 (a).

4. Has a quality assurance program that complies with subpart H of 10 CFR 71.

SECTION 88. DHS 157.93 (6) is repealed and recreated to read:

DHS 157.93 **(6)** (a) A general license is issued to any licensee to transport, or to deliver to a carrier for transport, licensed material in a package whose design has been approved in a foreign national competent authority certificate and which has been revalidated by the US department of transportation as meeting the applicable requirements of 49 CFR 171.23.

(am) The general license issued in par. (a) applies only to a licensee who has a quality assurance program approved by the commission as satisfying the applicable provision of s. DHS 157. 94 (6).

(b) The general license in par. (a) applies only to international shipments.

(c) The licensee issued a general license in par. (a) shall meet the following:

1. Maintain a copy of the applicable certificate, the revalidation, and the drawings and other documents referenced in the certificate relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment.

2. Comply with the terms and conditions of the certificate and revalidation, and with the requirements s. DHS 157.92 and 157.94.

SECTION 89. DHS 157.94 (3) is repealed and recreated to read:

DHS 157.94 **(3)** SHIPMENT AND PACKAGING RECORDS. (a) A licensee shall maintain for a period of 3 years after shipment, a record of each shipment of licensed material not exempt under s. DHS 157.92 (2), showing all of the following:

1. Identification of the packaging by model number and serial number.

2. Verification that the packaging, as shipped, had no significant defect.

3. Volume and identification of coolant.

4. Type and quantity of licensed material in each package and the total quantity of each shipment.

5. For each item of irradiated fissile material, the following:

a. Identification by model number and serial number.

b. Irradiation and decay history to the extent appropriate to demonstrate that its nuclear and thermal characteristics comply with license conditions.

c. Any abnormal or unusual condition relevant to radiation safety.

6. Date of the shipment.

7. For fissile package and for Type B package, any special controls exercised.

8. Name and address of the transferee.

9. Address to which the shipment was made.

10. Results of the determinations required by sub. (1) and by the conditions of the package approval.

(b) A licensee, certificate holder, and an applicant for a CoC, shall make available to the department for inspection, upon reasonable notice, of all records required by this subsection. Records are only valid if stamped, initialed, or signed and dated by authorized personnel, or otherwise authenticated.

(c) A licensee, certificate holder, and an applicant for a certificate of compliance shall maintain sufficient written records to furnish evidence of the quantity of packaging. The records to be maintained include results of the determinations required by s. DHS 157.94 (8); design, fabrication, and assembly records; results of reviews, inspections, tests, and audits; results of monitoring work performance and materials analyses; and results of maintenance, modification, and repair activities. Inspection, test, and audit records must identify the inspector or data recorder, the type of observation, the results, the acceptability, and the action taken in connection with any deficiencies noted. These records must be retained for 3 years after the life of the packaging to which they apply.

SECTION 90. DHS 157.94 (5) (a) is amended to read.

DHS 157.94 **(5)** (a) Prior to the transport of any nuclear waste meeting the criteria in par. (b) outside of the confines of the licensee's facility or other place of use or storage, or prior to the delivery of any nuclear waste to a carrier for transport, within or across the boundary of the State, each licensee shall provide advance notification of the transport to the governor of a state, or governor's designee, and to the department.

SECTION 91. DHS 157.94 (5) (am) and (Note) are created to read:

DHS 157.94 **(5)** (am) Prior to the transport of any nuclear waste meeting the criteria in par. (b) outside of the confines of the licensee's facility or other place of use or storage, or prior to the delivery of any nuclear waste to a carrier for transport, within or across the boundary of the federally recognized Indian tribe's reservation, each licensee shall provide advance notification of transport to the Indian tribal official of the participating Indian tribes or the Indian tribal official's designee, and to the department.

Note: Notification of transport of nuclear waste may be sent to: Division of Emergency Management, 2400 Wright Street, Madison, Wisconsin, 53704. Notification may also be made by: telephone at 608-242-3232; or fax at 608-242-3247. The telephone number of the 24-hour duty officer is 1-800-943-0003. Contact information for each State, including telephone and mailing addresses of governors and governors' designees, and participating Tribes, including telephone and mailing addresses of Tribal officials and Tribal official's designees, is available on the NRC Web site at: *https://scp.nrc.gov/special/designee.pdf*.

SECTION 92. DHS 157.94 (5) (c) 4., (d), (e), and (f) are amended to read:

DHS 157.94 **(5)** (c) 4. The 7-day period during which arrival of the shipment at state boundaries or Tribal reservation boundaries is estimated to occur.

DHS 157.94 **(5)** (d) The notification required by par. (a) shall be made in writing to the office of ~~the~~ each appropriate governor~~,~~ or governor's designee, the office of each appropriate tribal official or tribal official's designee, and to the department. A notification delivered by mail ~~must~~ shall be postmarked at least 7 days before the beginning of the 7-day period during which departure of the shipment is estimated to occur. A notification delivered by ~~messenger or facsimile~~ any other means than mail shall reach the office of the governor~~,~~ or governor's designee, the Indian tribal official or Indian tribal official's designee, and the department at least 4 days before the beginning of the 7-day period during which departure of the shipment is estimated to occur. A copy of the notification shall be retained by the licensee for 3 years.

(e) A licensee shall notify the governor~~,~~ or governor's designee, Indian tribal official or Indian tribal official's designee, and the department of any changes to schedule information provided under par. (a). Notification shall be by telephone ~~or facsimile~~ to a designated responsible individual in the office of the governor~~,~~ or governor's designee, Indian tribal official or Indian tribal official's designee, and to the department. A licensee shall retain for 3 years a record of the name of the individual contacted.

(f) A licensee who cancels a nuclear waste shipment for which advance notification has been sent shall send to the governor~~,~~ of each State or governor's designee previously notified, Indian tribal official or Indian tribal official's designee previously notified, and to the department a cancellation notice identifying the advance notification that is being canceled. A copy of the notice shall be retained by the licensee for 3 years.

SECTION 93. DHS 157.94 (6) is repealed and recreated to read:

DHS 157.94 **(6)** QUALITY ASSURANCE REQUIREMENTS. (a) A licensee, certificate holder, and applicant for a certificate of compliance are responsible for the quality assurance requirements as they apply to design, fabrication, testing, and modification of packaging. A licensee is responsible for the quality assurance provision which applies to its use of a packaging for the shipment of licensed material subject to this subchapter.

(b) A licensee, certificate holder, and applicant for a Certificate of Compliance shall establish, maintain, and execute a quality assurance program satisfying each of the applicable criteria of 10 CFR 71.101 through 71.137 and satisfying any specific provisions that are applicable to the licensee's activities including procurement of packaging. The licensee, certificate holder, and applicant for a CoC shall execute the applicable criteria in a graded approach to an extent that is commensurate with the quality assurance requirement's importance to safety.

(c) Before the use of any package for the shipment of licensed material subject to this subsection, a licensee shall obtain nuclear regulatory commission approval of its quality assurance program.

(d) A licensee, certificate holder, and applicant for a Certificate of Compliance shall be responsible for establishing and executing the quality assurance program. A licensee, certificate holder, and applicant for a Certificate of Compliance may delegate to others, such as contractors, agents, or consultants, the work of establishing and executing the quality assurance program, or any part of the quality assurance program, but shall retain responsibility for the program. These activities include performing the functions associated with attaining quality objectives and the quality assurance functions.

(e) The quality assurance functions include the following:

1. Assuring that an appropriate quality assurance program is established and effectively executed; and

2. Verifying, by procedures such as checking, auditing, and inspection, that activities affecting the safety-related functions have been performed correctly.

(f) Changes to a quality assurance program shall comply with the following:

1. Each quality assurance program approval holder shall submit in accordance with 10 CFR 71.1(a), a description of a proposed change to its NRC-approved quality assurance program that will reduce commitments in the program description as approved by the NRC.

a. The quality assurance program approval holder shall not implement the change before receiving NRC approval.

b. The description of a proposed change to the NRC-approved quality assurance program must identify the change, the reason for the change, and the basis for concluding that the revised

program incorporating the change continues to satisfy the applicable requirements of 10 CFR 71 subpart H.

2. Each quality assurance program approval holder may change a previously approved quality assurance program without prior NRC approval, if the change does not reduce the commitments in the quality assurance program previously approved by the NRC. Changes to the quality assurance program that do not reduce the commitments shall be submitted to the NRC every 24 months, in accordance with 10 CFR 71.1(a). In addition to quality assurance program changes involving administrative improvements and clarifications, spelling corrections, and non-substantive changes to punctuation or editorial items, the following changes are not considered reductions in commitment:

a. The use of a quality assurance standard approved by the NRC that is more recent than the quality assurance standard in the certificate holder's or applicant's current quality assurance program at the time of the change.

b. The use of generic organizational position titles that clearly denote the position function, supplemented as necessary by descriptive text, rather than specific titles, provided that there is no substantive change to either the functions of the position or reporting responsibilities.

c. The use of generic organizational charts to indicate functional relationships, authorities, and responsibilities, or alternatively, the use of descriptive text, provided that there is no substantive change to the functional relationships, authorities, or responsibilities.

d. The elimination of quality assurance program information that duplicates language in quality assurance regulatory guides and quality assurance standards to which the quality assurance program approval holder has committed to on record.

e. Organizational revisions that ensure that persons and organizations performing quality assurance functions continue to have the requisite authority and organizational freedom, including sufficient independence from cost and schedule when opposed to safety considerations.

3. Each quality assurance program approval holder shall maintain records of quality assurance program changes.

(g) The licensee, certificate holder, and applicant for a Certificate of Compliance shall maintain sufficient written records to describe the activities affecting quality.

1. The records shall include the following:

a. Changes to the quality assurance program as required by par. (f).

b. The documented instructions, procedures, or drawings of a type appropriate to the circumstances to prescribe quality assurance activities including appropriate quantitative and qualitative acceptance criteria for determining that activities important to quality have been satisfactorily accomplished.

c. Closely related specifications such as required qualifications of personnel, procedures, and equipment.

d. the instructions or procedures which establish a records retention program that is consistent with applicable regulations and designates factors such as duration, location, and assigned responsibility.

2. The licensee, certificate holder, and applicant for a Certificate of Compliance shall retain these records for 3 years beyond the date when the licensee, certificate holder, and applicant for a Certificate of Compliance last engages in the activity for which the quality assurance program was developed. If any portion of the quality assurance program, written procedures or instructions is superseded, the licensee, certificate holder, and applicant for a Certificate of Compliance shall retain the superseded material for 3 years after it is superseded.

SECTION 94. DHS 157.94 (8) (intro.) is amended to read:

DHS 157.94 **(8)** PRELIMINARY DETERMINATIONS. Prior to the first use of any packaging for the shipment of radioactive material a licensee shall ~~do all the following:~~ ascertain that the determination requirements in 10 CFR 71.85 (a) through (c) have been made.

SECTION 95. DHS 157.94 (8) (a) through (d) are repealed.

SECTION 96. DHS 157 Subchapter XV is created to read:

SUBCHAPTER XV

PHYSICAL PROTECTIONS OF CATEGORY 1 AND CATEGORY 2 QUANTITIES OF RADIOACTIVE MATERIAL

DHS 157.100 Personnel access authorization. (1) GENERAL REQUIREMENTS. (a) A licensee that possesses a quantity of radioactive material at or above the category 2 quantity of radioactive material threshold shall establish, implement, and maintain an access authorization program that meets the requirements of this subchapter.

(b) An applicant for a new license and a licensee that would become newly subject to the requirements of this subchapter upon application to amend its license shall implement the requirements of this subchapter as appropriate and be inspected by the department before taking possession of a category 1 or category 2 quantity of radioactive material.

(c) A licensee that has not previously implemented the physical protection license condition requirements or been subject to the provisions of this section and ss. DHS 157.101 to 157.106 shall implement the provisions of this section and ss. DHS 157.101 to 157.106 before aggregating radioactive material to a quantity that equals or exceeds the category 2 threshold.

(2) GENERAL PERFORMANCE OBJECTIVE. The licensee's access authorization program shall ensure that the individuals specified in sub. (3) (a) are trustworthy and reliable.

(3) APPLICABILITY. (a) A licensee shall subject all of the following individuals to the access authorization program specified under s. DHS 157.101:

1. An individual whose assigned duties require unescorted access to category 1 or category 2 quantities of radioactive material or to any device that contains the radioactive material.

2. An individual named as a reviewing official for the licensee.

(b) A licensee need not subject the categories of individuals listed in s. DHS 157.104 (1) (a) to (m) to the investigation elements of the access authorization program.

(c) Except as provided in par. (d), a licensee shall approve for unescorted access to category 1 or category 2 quantities of radioactive material only those individuals with job duties that require unescorted access to category 1 or category 2 quantities of radioactive material.

(d) A licensee may include individuals needing access to safeguards information-modified handling under 10 CFR 73 in the access authorization program under this section and ss. DHS 157.101 to 157.106.

DHS 157.101 Access authorization program. (1) GRANTING UNESCORTED ACCESS AUTHORIZATION. (a) A licensee shall implement the requirements of this subchapter for granting initial or reinstated unescorted access authorization.

(b) An individual who has been determined to be trustworthy and reliable shall complete the security training required under s. DHS 157.108 (3) before being allowed unescorted access to category 1 or category 2 quantities of radioactive material.

(2) REVIEWING OFFICIALS. (a) Only a reviewing official may make trustworthiness and reliability determinations that allow individuals to have unescorted access to category 1 or category 2 quantities of radioactive materials possessed by a licensee.

(b) Each licensee shall name one or more individuals to be a reviewing official. After completing a background investigation on the reviewing official, the licensee shall provide to the department, under oath or affirmation, a written certification that the reviewing official is deemed trustworthy and reliable by the licensee. The fingerprints of the named reviewing official shall be taken by a law enforcement agency, a federal or state agency that provides fingerprinting services to the public, or a commercial fingerprinting service authorized by a state to take fingerprints. Every 10 years, the licensee shall recertify that the reviewing official is deemed trustworthy and reliable under s. DHS 157.102 (3).

(c) The licensee shall permit its reviewing official to have unescorted access to category 1 or category 2 quantities of radioactive materials or access to safeguards information or safeguards information-modified handling, if the licensee possesses safeguards information or safeguards information-modified handling.

(d) A reviewing official may not approve other individuals to act as a reviewing official.

(e) A reviewing official does not need to undergo a new background investigation before being named by a licensee as the reviewing official if any of the following apply:

1. The individual has undergone a background investigation that included fingerprinting and a FBI criminal history records check and has been determined to be trustworthy and reliable by the licensee.

2. The individual is subject to a category listed in s. DHS 157.104 (1).

(3) INFORMED CONSENT. (a) A licensee may not initiate a background investigation without the informed and signed consent of the individual. This consent shall include authorization to share personal information with other individuals or organizations as necessary to complete the background investigation. Before making a final adverse determination, the licensee shall provide the individual with an opportunity to correct any inaccurate or incomplete information that is obtained during the background investigation. A licensee does not need to obtain a signed consent from those individuals that meet the requirements of s. DHS 157.102 (2). A signed consent shall be obtained before any reinvestigation.

(b) The subject individual may withdraw consent to a background investigation at any time. If an individual withdraws consent for a background investigation, the licensee shall inform the individual of all of the following:

1. The licensee may not initiate any elements of the background investigation that were not in progress at the time the individual withdrew consent.

2. A withdrawal of consent for a background investigation is sufficient cause for denial or termination of unescorted access authorization.

(4) PERSONAL HISTORY DISCLOSURE. An individual who applies for unescorted access authorization shall disclose the personal history information that is required by the licensee's access authorization program for the reviewing official to make a determination of the individual's trustworthiness and reliability. Refusal to provide, or the falsification of, any personal history information required under this subchapter is sufficient cause for denial or termination of unescorted access.

(5) DETERMINATION BASIS. (a) The reviewing official shall determine whether to permit, deny, unfavorably terminate, maintain, or administratively withdraw an individual's unescorted access authorization based on an evaluation of all the information collected to meet the requirements of this subchapter.

(b) The reviewing official may not permit any individual to have unescorted access until the reviewing official has evaluated all the information collected to meet the requirements of this section and has determined that the individual is trustworthy and reliable. The reviewing official

may deny unescorted access to any individual based on information obtained at any time during the background investigation.

(c) The reviewing official may terminate or administratively withdraw an individual's unescorted access authorization based on information obtained after the background investigation has been completed and the individual has been granted unescorted access authorization.

(d) A licensee shall document the basis for concluding whether or not there is reasonable assurance that an individual is trustworthy and reliable.

(e) A licensee shall maintain a list of individuals who are approved for unescorted access authorization. When a licensee determines that an individual no longer requires unescorted access or no longer meets the access authorization requirements, the licensee shall remove the individual from the approved list as soon as possible, but no later than 7 working days of that determination, and take prompt measures to ensure that the individual does not have unescorted access to category 1 or category 2 quantities of radioactive material.

(6) PROCEDURES. (a) A licensee shall develop, implement, and maintain written procedures for implementing the access authorization program. The procedures shall include provisions for providing notification to individuals who are denied unescorted access authorization, or whose unescorted access authorization is terminated; provisions for the review of the decision at the request of the affected individual; and provisions allowing the individual an opportunity to provide additional relevant information.

(b) The notification required under par. (a) shall include the grounds for denial or termination and the licensee's procedures on how the individual may request a review of the decision to deny or terminate the individuals unescorted access authorization.

(7) RIGHT TO CORRECT AND COMPLETE INFORMATION. (a) Before any final adverse determination is made, a licensee shall provide to each individual who is subject to a background investigation under this subchapter, written notice that the individual may complete, correct, and explain information obtained as a result of the background investigation. A copy of the notice and confirmation of receipt of the notice shall be maintained by the licensee for one year from the date of the notice.

(b) Challenge procedures may be initiated by an individual who believes that criminal history records obtained by the licensee are incorrect or incomplete in any respect, and who wishes to change, correct, update, or explain anything in the record. A licensee shall provide at least 10 days for an individual to challenge the results of an FBI criminal history records check after the record is made available for the individual's review. A licensee may make a final adverse determination based upon the criminal history records only after receipt of the FBI's confirmation or correction of the record.

Note: These procedures include direct application to the law enforcement agency that contributed the questioned information by the individual challenging the record, or a direct

challenge to the Federal Bureau of Investigation, Criminal Justice Information Services (CJIS) Division regarding the accuracy or completeness of any entry on the individual's criminal history record. In the latter case, the Federal Bureau of Investigation (FBI) will forward the challenge to the agency that submitted the data, and will request that the agency verify or correct the challenged entry. Upon receipt of an official communication directly from the agency that contributed the original information, the FBI Identification Division makes any changes necessary in accordance with the information supplied by that agency. An individual may challenge the accuracy or completeness of any entry on the criminal history record by applying directly to the Federal Bureau of Investigation, Criminal Justice Information Services (CJIS) Division, ATTN: SCU, Mod. D–2, 1000 Custer Hollow Road, Clarksburg, WV 26306 as set forth in 28 CFR 16.30 through 16.34.

(8) RECORDS. (a) A licensee shall retain documentation regarding the trustworthiness and reliability of individual employees for 3 years from the date the individual no longer requires unescorted access to category 1 or category 2 quantities of radioactive material.

(b) A licensee shall retain as a record for 3 years, a copy of any superseded portion of the access authorization program procedures, and a copy of current access authorization program procedures after they are no longer needed.

(c) A licensee shall retain the list of persons approved for unescorted access authorization for 3 years after the list is superseded or replaced.

DHS 157.102 Background investigations. (1) INITIAL INVESTIGATION. (a) *Background investigation elements.* Before allowing an individual unescorted access to category 1 or category 2 quantities of radioactive material or to the devices that contain the material, a licensee shall complete a background investigation of the individual seeking unescorted access authorization. The scope of the investigation shall encompass at least the 7 years preceding the date of the background investigation or the length of time since the individual's eighteenth birthday, whichever is shorter. The background investigation shall include at a minimum all of the following:

1. 'Criminal history check.' The licensee shall conduct fingerprinting and a FBI identification and criminal history records check under s. DHS 157.103.

2. 'Verification of true identity.' The licensee shall verify the true identity of the applicant. The licensee shall review official identification documents (e.g. driver's license; passport; government identification; certificate of birth issued by the state, province, or country of birth) and compare the documents to personal information provided by the individual to identify any discrepancy in the information. The licensee shall document the type, expiration, and identification number of the identification document, or maintain a photocopy of identifying documents on file under s. DHS 157.105. The licensee shall certify in writing that the identification was properly reviewed, and shall maintain the certification and all related documents for review upon inspection.

3. 'Employment history verification.' The licensee shall verify the applicant's employment history, including military history, with each employer for the 7 years immediately preceding the date of application.

4. 'Verification of education.' The licensee shall verify any educational credentials or experience claimed by the applicant.

5. 'Character and reputation determination.' The licensee shall complete reference checks to determine the character and reputation of the applicant. Unless other references are not available, references may not be obtained from any person who is known to be a close member of the applicant's family, including but not limited to the applicant's spouse, parents, siblings, or children, or any individual who resides in the applicant's permanent household. Reference checks under this subchapter shall be obtained for the limited purpose of determining whether the applicant has been and continues to be trustworthy and reliable.

6. 'Additional information.' The licensee shall, to the extent possible, obtain independent information to corroborate information provided by the applicant, including but not limited to, seeking references not supplied by the applicant.

(b) *Unresponsive background investigation.* If a current or previous employer, educational institution, or any other entity with which the applicant claims to have been engaged, fails to provide information, or indicates an inability or unwillingness to provide information, or if a licensee cannot reach the entity, within a time frame considered appropriate by the licensee but no more than 10 business days after the request, the licensee shall document the refusal, unwillingness, or inability in the background investigation record and attempt to obtain the information from an alternate source.

(2) GRANDFATHERING. (a) 1. Except as provided in subd. 2. an individual who has been determined to be trustworthy and reliable for unescorted access to category 1 or category 2 quantities of radioactive material under the fingerprint orders may continue to have unescorted access to category 1 and category 2 quantities of radioactive material without further investigation.

2. An individual grandfathered under subd. 1. shall be subject to the reinvestigation requirement under sub. (3).

(b) 1. Except a provided under subd. 2. an individual who has been determined to be trustworthy and reliable under 10 CFR 73 or the security orders for access to safeguards information, safeguards information-modified handling, or risk-significant material, may have unescorted access to category 1 and category 2 quantities of radioactive material without further investigation. A licensee shall document that the individual was determined to be trustworthy and reliable under 10 CFR 73 or a security order.

2. An individual grandfathered under subd. 1. shall be subject to the reinvestigation requirement under sub. 3.

(3) REINVESTIGATIONS. A licensee shall conduct a reinvestigation every 10 years for any individual with unescorted access to category 1 or category 2 quantities of radioactive material. The reinvestigation shall consist of fingerprinting and a FBI identification and criminal history records check under s. DHS 157.103. The reinvestigations shall be completed within 10 years of the date on which fingerprinting and an FBI identification and criminal history records check under s. DHS 157.103 were last completed.

DHS 157.103 Criminal history records checks of individuals granted unescorted access. (1) GENERAL PERFORMANCE OBJECTIVE AND REQUIREMENTS. (a) Except for those individuals listed in s. DHS 157.104 and those individuals grandfathered under s. DHS 157.102 (2), a licensee subject to the provisions of this subchapter shall fingerprint each individual seeking unescorted access to category 1 or category 2 quantities of radioactive material. The licensee shall transmit all collected fingerprints to the NRC for transmission to the FBI. The licensee shall use the information received from the FBI as part of the required background investigation to determine whether the individual will be granted or denied unescorted access to category 1 or category 2 quantities of radioactive materials.

(b) The licensee shall notify each affected individual that the individual's fingerprints will be used to secure a review of the individual's criminal history record, and shall also provide notice to the individual of the procedures for revising the record or adding explanations to the record.

(c) Fingerprinting is not required if a licensee is reinstating an individual's unescorted access authorization to category 1 or category 2 quantities of radioactive materials and all the following apply:

1. The individual returns to the same facility that granted unescorted access authorization within 365 days of the termination of his or her unescorted access authorization.

2. The individual's previous unescorted access authorization was terminated under favorable conditions.

(d) Fingerprints do not need to be taken if an individual, who is an employee of a licensee, contractor, manufacturer, or supplier, has been granted unescorted access to category 1 or category 2 quantities of radioactive material; access to safeguards information; or safeguards information-modified handling by another licensee based upon a background investigation conducted under this subchapter, fingerprint orders, or 10 CFR 73. An existing criminal history records check file may be transferred to a licensee asked to grant unescorted access under s. DHS 157.105 (3).

(e) A licensee shall use the information obtained as part of a criminal history records check solely to determine an individual's suitability for unescorted access authorization to category 1 or category 2 quantities of radioactive materials; access to safeguards information; or safeguards information-modified handling.

(2) PROHIBITIONS. (a) A licensee may not base a final determination to deny an individual unescorted access authorization to category 1 or category 2 quantities of radioactive material solely on the basis of information received from the FBI's criminal history records indicating any of the following:

1. An arrest more than one year old for which there is no information of the disposition of the case.

2. An arrest that resulted in dismissal of the charge or an acquittal.

(b) A licensee may not use information received from a criminal history records check obtained under this subchapter in a manner that would infringe upon the rights of any individual under the First Amendment to the Constitution of the United States, nor shall licensees use the information in any way that would discriminate among individuals on the basis of race, religion, national origin, gender, or age.

(3) PROCEDURES FOR PROCESSING OF FINGERPRINT CHECKS. (a) To comply with this subchapter, a licensee shall submit to the U.S. Nuclear Regulatory Commission, Director, Division of Facilities and Security, 11545 Rockville Pike, Rockville, Maryland 20852-2738, ATTN: Criminal History Program, Mail Stop TWB-05 B32M, one completed, legible standard fingerprint card (Form FD–258, ORIMDNRCOOOZ), an electronic fingerprint scan, or where practicable, other fingerprint record for each individual requiring unescorted access to category 1 or category 2 quantities of radioactive material. Copies of these forms may be obtained by writing the Office of the Chief Information Officer, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001, by calling 1–301-492-3531, or by email to FORMS.Resource@nrc.gov. Guidance on submitting electronic fingerprints can be found at http://www.nrc.gov/site-help/esubmittals.html.

(b) Fees for the processing of fingerprint checks are due upon application. The licensee shall submit payment with the application for the processing of fingerprints through corporate check, certified check, cashier's check, money order, or electronic payment, made payable to ''U.S. NRC.'' For guidance on making electronic payments, contact the Security Branch, Division of Facilities and Security at 301–415–7513. Combined payment for multiple applications is acceptable. The nuclear regulatory commission publishes the amount of the fingerprint check application fee on the NRC's public website. To find the current fee amount, go to the Electronic Submittals page at http://www.nrc.gov/site-help/e-submittals.html and see the link for the Criminal History Program under Electronic Submission Systems.

(c) The nuclear regulatory commission will forward to the submitting licensee all data received from the FBI as a result of a licensee's application for criminal history records checks.

DHS 157.104 Relief from fingerprinting, identification, and criminal history records checks and other elements of background investigation. (1) Fingerprinting, and the identification and criminal history records checks required by section 149 of the Atomic Energy Act of 1954, as amended, and other elements of the background investigation are not required for

the following individuals before granting unescorted access to category 1 or category 2 quantities of radioactive materials:

(a) An employee of the commission or of the executive branch of the U.S. government who has undergone fingerprinting for a prior U.S. government criminal history records check.

(b) A member of Congress.

(c) An employee of a member of Congress or congressional committee who has undergone fingerprinting for a prior U.S. government criminal history records check.

(d) The Governor of a state or his or her designated state employee representative.

(e) Federal, state, or local law enforcement personnel.

(f) State radiation control program directors and state homeland security advisors or their designated state employee representatives.

(g) Agreement state employees conducting security inspections on behalf of the NRC under an agreement executed under section 274.i. of the Atomic Energy Act.

(h) Representatives of the International Atomic Energy Agency (IAEA) engaged in activities associated with the U.S. IAEA Safeguards Agreement who have been certified by the NRC.

(i) Emergency response personnel who are responding to an emergency.

(j) Commercial vehicle drivers for road shipments of category 1 and category 2 quantities of radioactive material.

(k) Package handlers at transportation facilities such as freight terminals and railroad yards.

(L) Any individual who has an active federal security clearance, provided that he or she makes available to the licensee the appropriate documentation. Written confirmation from the agency or employer or both that granted the federal security clearance or reviewed the criminal history records check shall be provided to a licensee. The licensee shall retain documentation of an individual's federal security clearance and written confirmation from the agency, employer, or both that granted the federal security clearance or reviewed the criminal history records check for 3 years from the date the individual no longer requires unescorted access to category 1 or category 2 quantities of radioactive material.

(m) Any individual employed by a service provider licensee for which the service provider licensee has conducted the background investigation for the individual and approved the individual for unescorted access to category 1 or category 2 quantities of radioactive material. The service provider license shall provide written verification to the licensee. The

licensee shall retain the documentation of the written verification for 3 years from the date the individual no longer requires unescorted access to category 1 or category 2 quantities of radioactive material.

(2) Fingerprinting, and the identification and criminal history records checks required by section 149 of the Atomic Energy Act of 1954, as amended, are not required for an individual who has had a favorably adjudicated U.S. Government criminal history records check within the last 5 years, under a comparable U.S. Government program involving fingerprinting and a FBI identification and criminal history records check provided that he or she makes available the appropriate documentation. Written confirmation from the agency or employer or both that reviewed the criminal history records check shall be provided to the licensee. A licensee shall retain the provided documentation for 3 years from the date the individual no longer requires unescorted access to category 1 or category 2 quantities of radioactive material. These programs include, but are not limited to the following:

(a) National Agency Check.

(b) Transportation Worker Identification Credentials (TWIC) under 49 CFR 1572.

(c) Bureau of Alcohol, Tobacco, Firearms, and Explosives background check and clearances under 27 CFR 555.

(d) Health and Human Services security risk assessments for possession and use of select agents and toxins under 42 CFR 73.

(e) Hazardous Material security threat assessment for hazardous material endorsement to commercial driver's license under 49 CFR 1572.

(f) Customs and Border Protection's Free and Secure Trade (FAST) Program.

DHS 157.105 Protection of information. (1) Any licensee who obtains background investigation information on an individual under this subchapter shall establish and maintain a system of files and written procedures for protection of the record and the personal information from unauthorized disclosure.

(2) A licensee may not disclose the background investigation record or personal history information collected and maintained to persons other than the subject individual, the individual's representative, or to persons who need access to the information in order to perform assigned duties in the process of granting or denying unescorted access to category 1 or category 2 quantities of radioactive material, safeguards information, or safeguards information-modified handling. No individual authorized to have access to the information may disseminate the information to any other individual who does not have a need to know.

(3) The personal information obtained on an individual from a background investigation may be provided to another licensee under the following conditions:

(a) Upon the individual's written request to a licensee holding the data to disseminate the information contained in the individual's file.

(b) The recipient licensee verifies information such as name, date of birth, social security number, gender, and other applicable physical characteristics.

(4) The licensee shall make background investigation records obtained under this subchapter available for examination by the department.

(5) The licensee shall retain all fingerprint and criminal history records received from the FBI, including data indicating no record, , or a copy of these records if the individual's file has been transferred, for 3 years from the date the individual no longer requires unescorted access to category 1 or category 2 quantities of radioactive material.

DHS 157.106 Access authorization program review. (1) Each licensee shall be responsible for the continuing effectiveness of its access authorization program. Each licensee shall ensure that its access authorization program is reviewed for compliance with the requirements of this subchapter and that comprehensive actions are taken to correct any noncompliance that is identified. The licensee shall evaluate all program performance objectives and requirements. Each licensee shall periodically, and at least annually, review its access authorization program content and implementation.

(2) The licensee shall document the results of its access authorization program review and any recommendations. Documentation of the review shall identify conditions that are adverse to the proper performance of the access authorization program, the cause of the conditions, and, when appropriate, recommended corrective actions, and corrective actions taken. A licensee shall review the results of its access authorization program review and take any additional corrective actions necessary to preclude repetition of the condition, including additional review.

(3) The licensee shall maintain it access authorization program review records for 3 years.

DHS 157.107 Security program. (1) APPLICABILITY. (a) Any licensee that possesses a category 1 or category 2 quantity of radioactive material shall establish, implement, and maintain a security program under the requirements of this subchapter.

(b) An applicant for a new license and any licensee that would become newly subject to the requirements of this subchapter upon application for amendment of its license shall implement the applicable requirements of this subchapter and be inspected by the department, before taking possession of a category 1 or category 2 quantity of radioactive material.

(c) Any licensee that has not previously implemented the physical protection license condition requirements or been subject to ss. DHS 157.107 to 157.115 shall provide written notification to the department at least 90 days before aggregating radioactive material to a quantity that equals or exceeds the category 2 threshold.

(2) GENERAL PERFORMANCE OBJECTIVE. Each licensee shall establish, implement, and maintain a security program that is designed to monitor and immediately detect, assess, and respond to an actual or attempted unauthorized access to category 1 or category 2 quantities of radioactive material.

(3) PROGRAM FEATURES. Each licensee's security program shall comply with ss. DHS 157.108 to 157.114, as applicable.

DHS 157.108 General security program requirements. (1) SECURITY PLAN. (a) Any licensee identified in s. DHS 157.107 (1) shall develop a written security plan specific to its facilities and operations specifying the overall security strategy that ensures the integrated and effective functioning of the security program required by this subchapter. At a minimum, the security plan shall:

1. Describe the measures and strategies used to implement the requirements of this subchapter.

2. Identify the security resources, equipment, and technology used to satisfy the requirements of this subchapter.

(b) The security plan shall be reviewed and approved by the individual with overall responsibility for the security program.

(c) A licensee shall revise its security plan as necessary to ensure the department's requirements are effectively implemented. A licensee shall ensure all of the following:

1. The revision to the security plan has been reviewed and approved by the individual with overall responsibility for the security program.

2. Individuals affected by the revised security plan are notified and given instruction about changes to the plan before they are implemented.

(d) A licensee shall retain a copy of the current security plan as a record for 3 years after the security plan is no longer required. A licensee shall retain a record of any superseded portion of the security plan for 3 years after it is superseded.

(2) IMPLEMENTING PROCEDURES. (a) A licensee shall develop and maintain written procedures that document how the requirements of this subchapter and the security plan will be implemented.

(b) The implementing procedures and revisions to these procedures shall be approved in writing by the individual with overall responsibility for the security program.

(c) A licensee shall retain a copy of the current implementing procedures as a record for 3 years after they are no longer required. A licensee shall retain a record of any superseded portion of the implementing procedures for 3 years after they are superseded.

(3) TRAINING. (a) A licensee shall conduct training to ensure that individuals implementing the security program possess and maintain the knowledge, skills, and abilities required to carry out their assigned duties and responsibilities effectively. The training shall include instruction in all of the following:

1. The licensee's security program, implementing procedures, and the purposes and functions of the security measures employed to secure category 1 or category 2 quantities of radioactive material.

2. The responsibility to report promptly to the licensee any condition that causes or may cause a violation of the department's requirements.

3. The responsibility of the licensee to report promptly to the LLEA and licensee any actual or attempted theft, sabotage, or diversion of category 1 or category 2 quantities of radioactive material.

4. The appropriate response to security alarms.

(b) In determining those individuals who will be trained on the security program, a licensee shall consider each individual's assigned activities during authorized use and response to potential situations involving actual or attempted theft, diversion, or sabotage of category 1 or category 2 quantities of radioactive material. The extent of the training provided to an individual shall be commensurate with the individual's potential involvement in the security of category 1 or category 2 quantities of radioactive material.

(c) Refresher training shall be provided at a frequency not to exceed 12 months and when significant changes have been made to the security program. Refresher training shall include all of the following:

1. Review of the training requirements under sub. (3) and any changes made to the security program since the last training.

2. Reports on any relevant security issues, problems, and lessons learned.

3. Relevant results of the department's inspections.

4. Relevant results of the licensee's program review and testing and maintenance.

(d) A licensee shall maintain records of the initial and refresher training for 3 years from the date of the training. The training records shall include dates of the training, topics covered, a list of licensee personnel in attendance, and related information.

(4) PROTECTION OF INFORMATION. (a) A licensee authorized to possess category 1 or category 2 quantities of radioactive material shall limit access to and unauthorized disclosure of their security plan, implementing procedures, and the list of individuals that have been approved for unescorted access.

(b) Efforts to limit access shall include the development, implementation, and maintenance of written policies and procedures for controlling access to, and for proper handling and protection against unauthorized disclosure of the security plan and implementing procedures.

(c) Before granting an individual access to the security plan or implementing procedures, a licensee shall do all of the following:

1. Evaluate an individual's need to know the security plan or implementing procedures.

2. If the individual has not been authorized for unescorted access to category 1 or category 2 quantities of radioactive material, safeguards information, or safeguards information-modified handling, the licensee shall complete a background investigation to determine the individual's trustworthiness and reliability. A trustworthiness and reliability determination shall be conducted by the reviewing official and shall include the background investigation elements contained in s. DHS 157.102 (1) (a) 2. to 6. and (b).

(d) A licensee need not subject any of the following individuals to the background investigation elements for protection of information:

1. The categories of individuals listed in s. DHS 157.104 (1) (a) to (m).

2. Employees of security service providers for whom written verification has been provided to the licensee by the security service provider that indicates the employee has been determined to be trustworthy and reliable based upon the background investigation elements contained in ss. DHS 157.102 (1) (a) 2. to 6. and DHS 157.102 (2) .

(e) A licensee shall document the basis for concluding that an individual is trustworthy and reliable and should be granted access to the security plan or implementing procedures.

(f) A licensee shall maintain a list of persons currently approved for access to the security plan or implementing procedures. When a licensee determines that a person no longer needs access to the security plan or implementing procedures or no longer meets the access authorization requirements for access to the information, the licensee shall remove the person from the approved list as soon as possible, but no later than 7 working days, and take prompt measures to ensure that the individual cannot obtain the security plan or implementing procedures.

(g) When not in use, a licensee shall store its security plan and implementing procedures in a manner to prevent unauthorized access. Information stored in non-removable electronic form shall be password protected.

(h) A licensee shall retain all of the following as a record for 3 years after the document is no longer needed:

1. A copy of the information protection procedures.

2. The list of individuals approved for access to the security plan or implementing procedures.

DHS 157.109 LLEA coordination. (1) A licensee subject to this subchapter shall coordinate, to the extent practicable, with an LLEA for responding to threats to a licensee's facility, including any necessary armed response. The information provided to the LLEA shall include all the following:

(a) A description of the facilities and the category 1 and category 2 quantities of radioactive materials along with a description of the security measures that have been implemented by the licensee to comply with this subchapter.

(b) A notification that the licensee will request a timely armed response by the LLEA to any actual or attempted theft, sabotage, or diversion of category 1 or category 2 quantities of material.

(2) A licensee shall notify the department within 3 business days if any of the following occur:

(a) The LLEA has not responded to the request for coordination within 60 days of the coordination request.

(b) The LLEA notifies the licensee that the LLEA does not plan to participate in coordination activities.

(3) A licensee shall document its efforts to coordinate with the LLEA. The documentation shall be kept for 3 years.

(4) A licensee shall coordinate with the LLEA at least every 12 months, or when changes to the facility design or operation adversely affect the licensee's potential vulnerability to theft, sabotage, or diversion of its material.

DHS 157.110 Security zones. (1) A licensee shall ensure that all category 1 and category 2 quantities of radioactive material are used or stored within licensee established security zones. Security zones may be permanent or temporary.

(2) Temporary security zones shall be established as necessary to meet a licensee's transitory or intermittent business activities, such as periods of maintenance, source delivery, and source replacement.

(3) Unescorted access to security zones shall only be permitted to approved individuals through the following conditions, or combinations of conditions:

(a) Category 1 and category 2 quantities of radioactive materials are isolated by the use of continuous physical barriers that allow access to the security zone only through established access control points. A physical barrier is a natural or man-made structure or formation sufficient for the isolation of the category 1 or category 2 quantities of radioactive material within a security zone.

(b) The security zone is directly controlled by approved individuals at all times.

(4) For category 1 quantities of radioactive material during periods of maintenance, source receipt, preparation for shipment, installation, or source removal or exchange, a licensee shall, at a minimum, provide sufficient numbers of individuals approved for unescorted access to maintain continuous surveillance of sources in temporary security zones and in any security zone in which physical barriers or intrusion detection systems have been disabled to allow such activities.

(5) Individuals not approved for unescorted access to category 1 or category 2 quantities of radioactive material shall be escorted by an approved individual when in a security zone.

DHS 157.111 Monitoring, detection, assessment, communication, and response. (1) MONITORING AND DETECTION. (a) A licensee shall establish and maintain the capability to continuously monitor and immediately detect all unauthorized entries into its security zones. A licensee shall provide the means to maintain continuous monitoring and detection capability if the primary power source is lost, or provide for an alarm and response if this capability to continuously monitor and immediately detect unauthorized entries is lost.

(b) Monitoring and detection shall be performed by at least one of the following:

1. A monitored intrusion detection system that is linked to an onsite or offsite central monitoring facility.

2. Electronic devices for intrusion detection alarms that will alert nearby facility personnel.

3. A monitored video surveillance system.

4. Direct visual surveillance by approved individuals located within the security zone.

5. Direct visual surveillance by a licensee designated individual located outside the security zone.

(c) A licensee subject to this subchapter shall detect unauthorized removal of the radioactive material from the security zone by establishing and maintaining the following capabilities:

1. For category 1 quantities of radioactive material, immediate detection of any attempted unauthorized removal of the radioactive material from the security zone. Immediate detection capability shall be provided by any of the following:

a. Electronic sensors linked to an alarm.

b. Continuous monitored video surveillance.

c. Direct visual surveillance.

2. For category 2 quantities of radioactive material, weekly verification through physical checks, tamper indicating devices, use, or other means to ensure that the radioactive material is present.

(2) ASSESSMENT OF ACTUAL OR ATTEMPTED UNAUTHORIZED ENTRY. A licensee shall immediately assess each actual or attempted unauthorized entry into the security zone to determine whether the unauthorized access was an actual or attempted theft, sabotage, or diversion.

(3) PERSONNEL COMMUNICATIONS AND DATA TRANSMISSION. For personnel and automated or electronic systems supporting a licensee's monitoring, detection, and assessment systems, a licensee shall comply with all of the following:

(a) Maintain continuous communication capability for personnel and electronic data transmission and processing capability among site security systems.

(b) Provide an alternative communication capability for personnel, and an alternative data transmission and processing capability if the primary means of communication or data transmission and processing is lost. Alternative communications and data transmission systems shall not be subject to the same failure modes as the primary systems.

(4) RESPONSE TO ACTUAL OR ATTEMPTED UNAUTHORIZED ACCESS, THEFT, SABOTAGE, OR DIVERSION. A licensee shall immediately respond to any actual or attempted unauthorized access to the security zones, or actual or attempted theft, sabotage, or diversion of category 1 or category 2 quantities of radioactive material at licensee facilities or temporary job sites. For any unauthorized access involving an actual or attempted theft, sabotage, or diversion of category 1 or category 2 quantities of radioactive material, a licensee's response shall include immediately requesting an armed response from the LLEA.

DHS 157.112 Maintenance and testing. (1) Any licensee subject to this subchapter shall implement a maintenance and testing program to ensure that intrusion alarms, associated communication systems, and other physical components of the systems used to secure or detect unauthorized access to radioactive material are maintained in operable condition and are capable of performing their intended function when needed. The equipment relied on to meet the security requirements of this subchapter shall be inspected and tested for operability and

performance at the frequency suggested by the manufacturer. If there is no suggested frequency by the manufacturer, testing shall be performed, at a minimum, every 12 months.

(2) A licensee shall maintain records documenting maintenance and testing activities for 3 years.

DHS 157.113 Requirements for mobile devices. (1) Any licensee that possesses mobile devices containing category 1 or category 2 quantities of radioactive material shall comply with all the following:

(a) Have 2 independent physical controls, forming tangible barriers that secure the material from unauthorized removal when the mobile device is not under direct control and constant surveillance by the licensee.

(b) For a mobile device in or on a vehicle or trailer, unless the health and safety requirements for a site prohibit the disabling of the vehicle, a licensee shall use a method to disable the vehicle or trailer when not under direct control and constant surveillance by the licensee. A licensee shall not rely on the removal of an ignition key to meet this requirement.

DHS 157.114 Security program review. (1) Each licensee shall be responsible for the continuing effectiveness of the security program. Each licensee shall review the security program to confirm compliance with the requirements of this subchapter and to ensure that comprehensive actions are taken to correct any noncompliance. The licensee shall review the radioactive material security program content and implementation periodically, and at least annually.

(2) The licensee shall document the results of the review, along with any recommendations, identify conditions that are adverse to the proper performance of the security program, the cause of the condition, and, when appropriate, recommend corrective actions, and corrective actions taken. A licensee shall review the results of the review and take any additional corrective actions necessary to preclude repetition of adverse conditions, including further review.

(3) A licensee shall maintain the review documentation for 3 years.

DHS 157.115 Reporting events. (1) A licensee shall immediately notify the LLEA after determining that an unauthorized entry resulted in an actual or attempted theft, sabotage, or diversion of a category 1 or category 2 quantity of radioactive material. A licensee shall notify the department by telephone as soon as possible after initiating a response, but not at the expense of causing delay or interfering with the LLEA response to the event. In no case shall the notification to the department be later than 4 hours after the discovery of any attempted or actual theft, sabotage, or diversion.

(2) A licensee shall assess any suspicious activity related to possible theft, sabotage, or diversion of category 1 or category 2 quantities of radioactive material and notify the LLEA as

appropriate. A licensee shall notify the department by telephone as soon as possible but not later than 4 hours after notifying the LLEA.

(3) Within 30 days of the initial notification by phone required in subs. (1) and (2), the licensee shall also submit a written report to the department. The written report shall include sufficient information for department analysis and evaluation, including identification of any necessary corrective actions to prevent future instances.

Note: The department may be contacted at: Department of Health Services, Radiation Protection Section, P.O. Box 2659, Madison, WI, 53701−2659. Telephone contact is: 608−267−4797 during normal business hours or 608−258−0099 after hours.

DHS 157.116 Additional requirements for transfer of category 1 and category 2 quantities of radioactive material. A licensee transferring a category 1 or category 2 quantity of radioactive material to a licensee of the department, the NRC, or another agreement state shall meet all of the following license verification provisions instead of those listed in s. DHS 157.13 (15) (d):

(1) Before transferring a category 1 quantity of radioactive material, the licensee making the transfer shall verify with the NRC's license verification system or the license issuing authority that the transferee's license authorizes the receipt of the type, form, and quantity of radioactive material to be transferred and that the transferee is authorized to receive radioactive material at the location requested for delivery. If the verification is conducted by contacting the license issuing authority, the licensee making the transfer shall document the verification. Verification is not needed for transfers within the same organization.

(2) Before transferring a category 2 quantity of radioactive material, the licensee making the transfer shall verify with the NRC's license verification system or the license issuing authority that the transferee's license authorizes the receipt of the type, form, and quantity of radioactive material to be transferred. If the verification is conducted by contacting the license issuing authority, the transferor shall document the verification. Verification is not needed for transfers within the same organization.

(3) In an emergency where a licensee making the transfer cannot reach the license issuing authority and the license verification system is nonfunctional, a licensee may accept a written certification by the transferee that it is authorized by license to receive the type, form, and quantity of radioactive material to be transferred. The certification shall include the transferee's license number, current revision number, issuing agency, expiration date, and for a category 1 shipment, the authorized address. The licensee making the transfer shall keep a copy of the certification and shall confirm the certification through the NRC's license verification system or by contacting the license issuing authority by the end of the next business day.

(4) The licensee transferring the radioactive material shall keep a copy of the verification documentation as a record for 3 years.

DHS 157.117 Transit. (1) For shipments of category 1 quantities of radioactive material, each shipping licensee shall comply with the requirements for physical protection contained in ss. DHS 157.118 (1) and (5), 157.119, 157.120 (1) (a), (2) (a), and (3), 157.121 (1), (3), (5), (7) and (8).

(2) For shipments of category 2 quantities of radioactive material, each shipping licensee shall comply with the requirements for physical protection contained in ss. DHS 157.118 (2) to (5), 157.120 (1) (b) and (c), (2) (b), and (3), 157.121 (2), (4), and (6) to (8). For those shipments of category 2 quantities of radioactive material that meet the criteria of s. DHS 157.94 (5) (b), the shipping licensee shall also comply with the advance notification provisions of s. DHS 157.94 (5).

(3) The shipping licensee shall be responsible for meeting the requirements of this subchapter unless the receiving licensee has agreed in writing to implement the physical protection requirements under this subchapter for materials in transit.

DHS 157.118 Preplanning and coordination of shipments. (1) Any licensee that plans to transport, or deliver to a carrier for transport, licensed material that is a category 1 quantity of radioactive material outside the confines of the licensee's facility or other place of use or storage shall complete all of the following:

(a) Preplan and coordinate shipment arrival and departure times with the receiving licensee.

(b) Preplan and coordinate shipment information with the governor or the governor's designee of any state through which the shipment will pass to discuss the state's intention to provide law enforcement escorts and identify safe havens.

(c) Document the preplanning and coordination activities.

(2) Any licensee that plans to transport, or deliver to a carrier for transport, licensed material that is a category 2 quantity of radioactive material outside the confines of the licensee's facility or other place of use or storage shall coordinate the shipment no-later-than arrival time and the expected shipment arrival with the receiving licensee. A licensee shall document the coordination activities.

(3) Any licensee who receives a shipment of a category 2 quantity of radioactive material shall confirm receipt of the shipment with the originator. If the shipment has not arrived by the no-later-than arrival time, the receiving licensee shall notify the originator.

(4) Any licensee who transports or plans to transport a shipment of a category 2 quantity of radioactive material, and determines that the shipment will arrive after the no-later-than arrival time provided under sub. (2), shall promptly notify the receiving licensee of the new no-later-than arrival time.

(5) A licensee shall retain a copy of the documentation for preplanning and coordination, and any revision thereof, as a record for 3 years.

DHS 157.119 Advance notification of shipment. A licensee shall provide advanced notification, as provided in subs. (1) and (2),of the shipment of licensed material in a category 1 quantity, to, within, or across the boundary of the state, before the shipment, or before delivery to a carrier for shipment of the licensed material outside the confines of the licensee's facility or other place of use or storage.

(1) PROCEDURES FOR SUBMITTING ADVANCE NOTIFICATION. (a) The notification shall be made to the department and to the office of each governor or governor's designee of any state to, within, or through which the material is shipped. The contact information, including telephone and mailing addresses, of governors and governors' designees, is available on the U.S. Nuclear Regulatory Commission website at http:// http://scp.nrc.gov/special/designee.pdf. A list of the contact information is also available upon request from the Director, Division of Material Safety, State, Tribal, and Rulemaking Programs, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001.

(b) A notification delivered by mail shall be postmarked at least 7 days before transport of the shipment commences at the shipping facility.

(c) A notification delivered by any means other than mail shall reach the department at least 4 days before the transport of the shipment commences and shall reach the office of any governor or the governor's designee at least 4 days before transport of a shipment to, within, or through the state.

Note: The department may be contacted at: Department of Health Services, Radiation Protection Section, P.O. Box 2659, Madison, WI, 53701−2659. Telephone contact is: 608−267−4797 during normal business hours or 608−258−0099 after hours.

(2) INFORMATION TO BE FURNISHED IN ADVANCE NOTIFICATION. Each advance notification of shipment of category 1 quantities of radioactive material shall contain all of the following information, if available at the time of notification:

(a) The name, address, and telephone number of the shipper, carrier, and receiver of the category 1 radioactive material.

(b) The license numbers of the shipper and receiver.

(c) A description of the radioactive material contained in the shipment, including the radionuclides and quantity.

(d) The point of origin of the shipment and the estimated time and date that shipment will commence.

(e) The estimated time and date that the shipment is expected to enter each state along the route.

(f) The estimated time and date of arrival of the shipment at the destination.

(g) A point of contact, with a telephone number, for current shipment information.

(3) REVISION NOTICE. (a) A licensee shall provide any information not previously available at the time of the initial notification, as soon as the information becomes available but not later than commencement of the shipment, to the governor of the state or the governor's designee and to the department.

(b) A licensee shall promptly notify the governor of the state or the governor's designee of any changes to the information provided under subs. (1) and (3) (a). A licensee shall also immediately notify the department of any such changes.

(4) CANCELLATION NOTICE. Any licensee who cancels a shipment for which advance notification has been sent shall send a cancellation notice to the department and to the governor of each state or to the governor's designee previously notified. The licensee shall send the cancellation notice before the shipment would have commenced or as soon thereafter as possible. The licensee shall state in the notice that it is a cancellation and identify the advance notification that is being cancelled.

(5) RECORDS. A licensee shall retain a copy of the advance notification and any revision and cancellation notices as a record for 3 years.

(6) PROTECTION OF INFORMATION. State officials, state employees, and other individuals, whether or not licensees of the Commission or an Agreement State, who receive schedule information of the kind specified in sub. (2) shall protect that information against unauthorized disclosure as specified in s. DHS 157.108 (4).

DHS 157.120 Physical protection during shipment. (1) SHIPMENTS BY ROAD. (a) Any licensee who transports, or delivers to a carrier for transport, in a single shipment, a category 1 quantity of radioactive material by road shall do all the following:

1. Ensure that movement control centers are established to maintain position information of the shipment from a remote location. These movement control centers shall monitor shipments at all times, and have the ability to immediately communicate with the appropriate law enforcement agencies in an emergency.

2. Ensure that redundant communications are established that allow the transporter to contact the escort vehicle and movement control center at all times. Redundant communications shall not be subject to the same interference factors as the primary communication.

3. Ensure that shipments are continuously and actively monitored by a telemetric position monitoring system or an alternative tracking system reporting to a movement control center. A

movement control center shall provide positive confirmation of the location, status, and control over the shipment. The movement control center shall be prepared to promptly implement preplanned procedures in response to deviations from the authorized route or a notification of actual, attempted, or suspicious activities related to the theft, loss, or diversion of a shipment. These procedures will include, but not be limited to, the identification of and contact information for the appropriate LLEA along the shipment route.

4. Provide an individual to accompany the driver for highway shipments with a driving time period greater than the maximum number of allowable hours of service in a 24-hour duty day as established by the U.S. department of transportation federal motor carrier safety administration. The accompanying individual may be another driver.

5. Develop written normal and contingency procedures to address all the following:

a. Notifications to the communication center and law enforcement agencies.

b. Communication protocols. Communication protocols shall include a strategy for the use of authentication codes and duress codes and provisions for refueling or other stops, detours, and locations where communication is expected to be temporarily lost.

c. Loss of communications.

d. Responses to an actual or attempted theft or diversion of a shipment.

6. Ensure that drivers, accompanying personnel, and movement control center personnel have access to the normal and contingency procedures.

(b) Any licensee that transports category 2 quantities of radioactive material shall maintain constant control or surveillance or both during transit and have the capability for immediate communication to summon appropriate response or assistance.

(c) Any licensee who delivers to a carrier for transport, in a single shipment, a category 2 quantity of radioactive material shall do all of the following:

1. Use carriers that have established package tracking systems. An established package tracking system is a documented, proven, and reliable system routinely used to transport objects of value. In order for a package tracking system to maintain constant control or surveillance or both, the package tracking system shall allow the shipper or transporter to identify when and where the package was last and when it should arrive at the next point of control.

2. Use carriers that maintain constant control or surveillance or both during transit and have the capability for immediate communication to summon appropriate response or assistance; and

3. Use carriers that have established tracking systems that require an authorized signature before releasing the package for delivery or return.

(2) SHIPMENTS BY RAIL. (a) Any licensee who transports, or delivers to a carrier for transport, in a single shipment, a category 1 quantity of radioactive material by rail shall do all the following:

1. Ensure that rail shipments are monitored by a telemetric position monitoring system or an alternative tracking system that reports to the licensee, third party, or railroad communications center. The communications center shall provide positive confirmation of the location of the shipment and its status. The communications center shall implement preplanned procedures in response to deviations from the authorized route or to a notification of actual, attempted, or suspicious activities related to the theft or diversion of a shipment. These procedures will include, but not be limited to, the identification of and contact information for the appropriate LLEA along the shipment route.

2. Ensure that periodic reports to the communications center are made at preset intervals.

(b) Any licensee who transports, or delivers to a carrier for transport, in a single shipment, a category 2 quantity of radioactive material by rail shall do all the following:

1. Use carriers that have established package tracking systems. An established package tracking system is a documented, proven, and reliable system routinely used to transport objects of value. In order for a package tracking system to maintain constant control or surveillance or both, the package tracking system shall allow the shipper or transporter to identify when and where the package was last reported and when it should arrive at the next point of control.

2. Use carriers that maintain constant control or surveillance or both during transit and have the capability for immediate communication to summon appropriate response or assistance.

3. Use carriers that have established tracking systems that require an authorized signature before releasing the package for delivery or return.

(3) INVESTIGATIONS. Any licensee who makes arrangements for the shipment of category 1 quantities of radioactive material shall immediately conduct an investigation upon the discovery that a category 1 shipment is lost or missing. Any licensee who makes arrangements for the shipment of category 2 quantities of radioactive material shall immediately conduct an investigation, in coordination with the receiving licensee, of any shipment that has not arrived by the designated no-later-than arrival time.

DHS 157.121 Reporting of events during shipping. (1) The shipping licensee shall notify the LLEA in the area of the shipment's last confirmed location and the department by telephone within one hour of its determination that a shipment of category 1 quantities of radioactive material is lost or missing. During the investigation required by s. DHS 157.120 (3), the shipping licensee shall provide agreed upon updates to the department on the status of the investigation.

(2) The shipping licensee shall initially notify the department by telephone within 4 hours of the shipping licensee's determination that a shipment of category 2 quantities of radioactive material is lost or missing. The licensee shall further notify the department, if the radioactive material has not been located and secured after 24 hours of the initial determination that the shipment is lost or missing.

(3) The shipping licensee shall notify the designated LLEA along the shipment route as soon as possible upon discovery of any actual or attempted theft or diversion of a shipment or suspicious activities related to the theft or diversion of a shipment of a category 1 quantity of radioactive material. As soon as possible after notifying the LLEA, the licensee shall notify the department by telephone upon discovery of any actual or attempted theft or diversion of a shipment, or any suspicious activity related to the shipment of category 1 radioactive material.

(4) The shipping licensee shall notify the department by telephone as soon as possible upon discovery of any actual or attempted theft or diversion of a shipment, or any suspicious activity related to the shipment, of a category 2 quantity of radioactive material.

(5) The shipping licensee shall notify the department by telephone and the LLEA as soon as possible upon recovery of any lost or missing category 1 quantities of radioactive material.

(6) The shipping licensee shall notify the department by telephone as soon as possible upon recovery of any lost or missing category 2 quantities of radioactive material.

(7) The licensee shall submit a written report to the department within 30 days of providing the telephone notification to an LLEA or the department of the discovery of any actual or attempted theft or diversion of a shipment under subs. (1) to (4). A written report is not required for notifications of suspicious activities related to a shipment. The report shall set forth all the following information:

(a) A description of the licensed material involved, including kind, quantity, and chemical and physical form.

(b) A description of the circumstances under which the loss or theft occurred.

(c) A statement of disposition, or probable disposition, of the licensed material involved.

(d) Actions that have been taken, or will be taken, to recover the material.

(e) Procedures or measures that have been, or will be, adopted to ensure against a recurrence of the loss or theft of licensed material.

(8) After filing the written report under sub. (7), a licensee shall report to the department any additional substantive information on the loss or theft of the category 1 or category 2 quantity of radioactive material within 30 days after the licensee learns of such information.

Note: The department may be contacted at: Department of Health Services, Radiation Protection Section, P.O. Box 2659, Madison, WI, 53701−2659. Telephone contact is: 608−267−4797 during normal business hours or 608−258−0099 after hours.

DHS 157.122 Record requirements for the physical protection of Category 1 and 2 quantities of radioactive material. (1) FORM OF RECORDS. Each record required by this subchapter shall be legible throughout the retention period specified under sub. (2). The record may be the original or a reproduced copy or a microform, provided that the copy or microform is authenticated by authorized personnel and that the microform is capable of producing a clear copy throughout the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, and specifications shall include all pertinent information such as stamps, initials, and signatures. A licensee shall maintain adequate safeguards against tampering with and loss of records.

(2) RECORD RETENTION. A licensee shall maintain the records that are required under this subchapter for the period specified by the applicable provision. If a retention period is not otherwise specified, records shall be retained until the department terminates the facility's license. All records related to this subchapter may be destroyed upon the department's termination of the facility license.

SECTION 97. DHS 157 Appendix A is repealed and recreated to read:

Chapter DHS 157

APPENDIX A

Exempt Concentrations

Element (atomic number)	Radionuclide	Column I Gas concentration µCi/ml 1/	Column II Liquid and solid concentration
Antimony (51)	Sb−122		$3X10^{-4}$
	Sb−124		$2X10^{-4}$
	Sb−125		$1X10^{-3}$
Argon (18)	Ar−37	$1X10^{-3}$	
	Ar−41	$4X10^{-7}$	
Arsenic (33)	As−73		$5X10^{-3}$
	As−74		$5X10^{-4}$
	As−76		$2X10^{-4}$
	As−77		$8X10^{-4}$
Barium (56)	Ba−131		$2X10^{-3}$
	Ba−140		$3X10^{-4}$
Beryllium (4)	Be−7		$2X10^{-2}$
Bismuth (83)	Bi−206		$4X10^{-4}$
Bromine (35)	Br−82	$4X10^{-7}$	$3X10^{-3}$
Cadmium (48)	Cd−109		$2X10^{-3}$
	Cd−115m		$3X10^{-4}$
	Cd−115		$3X10^{-4}$
Calcium (20)	Ca−45		$9X10^{-5}$
	Ca−47		$5X10^{-4}$
Carbon (6)	C−14	$1X10^{-6}$	$8X10^{-3}$
Cerium (58)	Ce−141		$9X10^{-4}$
	Ce−143		$4X10^{-4}$
	Ce−144		$1X10^{-4}$
Cesium (55)	Cs−131		$2X10^{-2}$
	Cs−134m		$6X10^{-2}$
	Cs−134		$9X10^{-5}$
Chlorine (17)	Cl−38	$9X10^{-7}$	$4X10^{-3}$
Chromium (24)	Cr−51		$2X10^{-2}$
Cobalt (27)	Co−57		$5X10^{-3}$
	Co−58		$1X10^{-3}$
	Co−60		$5X10^{-4}$
Copper (29)	Cu−64		$3X10^{-3}$
Dysprosium (66)	Dy−165		$4X10^{-3}$
	Dy−166		$4X10^{-4}$
Erbium (68)	Er−169		$9X10^{-4}$
	Er−171		$1X10^{-3}$
Europium (63)	Eu−152(9.2 h)		$6X10^{-4}$
	Eu−155		$2X10^{-3}$
Fluorine (9)	F−18	$2X10^{-6}$	$8X10^{-3}$

1/ Values are given in Column I only for those materials normally used as gases.
2/ µCi/g for solids

Element (atomic number)	Radionuclide	Column I Gas concentration µCi/ml 1/	Column II Liquid and solid concentration
Gadolinium (64)	Gd−153		$2X10^{-3}$
	Gd−159		$8X10^{-4}$
Gallium (31)	Ga−72		$4X10^{-4}$
Germanium (32)	Ge−71		$2X10^{-2}$
Gold (79)	Au−196		$2X10^{-3}$
	Au−198		$5X10^{-4}$
	Au−199		$2X10^{-3}$
Hafnium (72)	Hf−181		$7X10^{-4}$
Hydrogen (1)	H−3	$5X10^{-6}$	$3X10^{-2}$
Indium (49)	In−113m		$1X10^{-2}$
	In−114m		$2X10^{-4}$
Iodine (53)	I−126	$3X10^{-9}$	$2X10^{-5}$
	I−131	$3X10^{-9}$	$2X10^{-5}$
	I−132	$8X10^{-8}$	$6X10^{-4}$
	I−133	$1X10^{-8}$	$7X10^{-5}$
	I−134	$2X10^{-7}$	$1X10^{-3}$
Iridium (77)	Ir−190		$2X10^{-3}$
	Ir−192		$4X10^{-4}$
	Ir−194		$3X10^{-4}$
Iron (26)	Fe−55		$8X10^{-3}$
	Fe−59		$6X10^{-4}$
Krypton (36)	Kr−85m	$1X10^{-6}$	
	Kr−85	$3X10^{-6}$	
Lanthanum (57)	La−140		$2X10^{-4}$
Lead (82)	Pb−203		$4X10^{-3}$
Lutetium (71)	Lu−177		$1X10^{-3}$
Manganese (25)	Mn−52		$3X10^{-4}$
	Mn−54		$1X10^{-3}$
	Mn−56		$1X10^{-3}$
Mercury (80)	Hg−197m		$2X10^{-3}$
	Hg−197		$3X10^{-3}$
	Hg−203		$2X10^{-4}$
Molybdenum (42)	Mo−99		$2X10^{-3}$
Neodymium (60)	Nd−147		$6X10^{-4}$
	Nd−149		$3X10^{-3}$
Nickel (28)	Ni−65		$1X10^{-3}$
Niobium (Columbium) (41)	Nb−95		$1X10^{-3}$
	Nb−97		$9X10^{-3}$
Osmium (76)	Os−185		$7X10^{-4}$

	Os−191m		$3X10^{-2}$
	Os−191		$2X10^{-3}$
	Os−193		$6X10^{-4}$
Palladium (46)	Pd−103		$3X10^{-3}$
	Pd−109		$9X10^{-4}$
Phosphorus (15)	P−32		$2X10^{-4}$
Platinum (78)	Pt−191		$1X10^{-3}$
	Pt−193m		$1X10^{-2}$

1/ Values are given in Column I only for those materials normally used as gases.
2/ µCi/g for solids

Element (atomic number)	**Radionuclide**	**Column I Gas concentration µCi/ml 1/**	**Column II Liquid and solid concentration**
	Pt−197m		$1X10^{-2}$
	Pt−197		$1X10^{-3}$
Potassium (19)	K−42		$3X10^{-3}$
Praseodymium (59)	Pr−142		$3X10^{-4}$
	Pr−143		$5X10^{-4}$
Promethium (61)	Pm−147		$2X10^{-3}$
	Pm−149		$4X10^{-4}$
Rhenium (75)	Re−183		$6X10^{-3}$
	Re−186		$9X10^{-4}$
	Re−188		$6X10^{-4}$
Rhodium (45)	Rh−103m		$1X10^{-1}$
	Rh−105		$1X10^{-3}$
Rubidium (37)	Rb−86		$7X10^{-4}$
Ruthenium (44)	Ru−97		$4X10^{-3}$
	Ru−103		$8X10^{-4}$
	Ru−105		$1X10^{-3}$
	Ru−106		$1X10^{-4}$
Samarium (62)	Sm−153		$8X10^{-4}$
Scandium (21)	Sc−46		$4X10^{-4}$
	Sc−47		$9X10^{-4}$
	Sc−48		$3X10^{-4}$
Selenium (34)	Se−75		$3X10^{-3}$
Silicon (14)	Si−31		$9X10^{-3}$
Silver (47)	Ag−105		$1X10^{-3}$
	Ag−110m		$3X10^{-4}$
	Ag−111		$4X10^{-4}$
Sodium (11)	Na−24		$2X10^{-3}$
Strontium (38)	Sr−85		$1X10^{-3}$
	Sr−89		$1X10^{-4}$
	Sr−91		$7X10^{-4}$
	Sr−92		$7X10^{-4}$
Sulfur (16)	S−35	$9X10^{-8}$	$6X10^{-4}$
Tantalum (73)	Ta−182		$4X10^{-4}$
Technetium (43)	Tc−96m		$1X10^{-1}$

	Tc−96		$1X10^{-3}$
Tellurium (52)	Te−125m		$2X10^{-3}$
	Te−127m		$6X10^{-4}$
	Te−127		$3X10^{-3}$
	Te−129m		$3X10^{-4}$
	Te−131m		$6X10^{-4}$
	Te−132		$3X10^{-4}$
Terbium (65)	Tb−160		$4X10^{-4}$
Thallium (81)	Tl−200		$4X10^{-3}$
	Tl−201		$3X10^{-3}$
	Tl−202		$1X10^{-3}$
	Tl−204		$1X10^{-3}$
Thulium (69)	Tm−170		$5X10^{-4}$

1/ Values are given in Column I only for those materials normally used as gases.
2/ µCi/g for solids

Element (atomic number)	**Radionuclide**	**Column I Gas concentration µCi/ml 1/**	**Column II Liquid and solid concentration µCi/ml 2/**
	Tm−171		$5X10^{-3}$
Tin (50)	Sn−113		$9X10^{-4}$
	Sn−125		$2X10^{-4}$
Tungsten (Wolfram) (74)	W−181		$4X10^{-3}$
	W-187		$7X10^{-4}$
Vanadium (23)	V-48		$3X10^{-4}$
Xenon (54)	Xe−131m	$4X10^{-6}$	
	Xe−133	$3X10^{-6}$	
	Xe−135	$1X10^{-6}$	
Ytterbium (70)	Yb−175		$1X10^{-3}$
Yttrium (39)	Y−90		$2X10^{-4}$
	Y−91m		$3X10^{-2}$
	Y−91		$3X10^{-4}$
	Y−92		$6X10^{-4}$
	Y−93		$3X10^{-4}$
Zinc (30)	Zn−65		$1X10^{-3}$
	Zn−69m		$7X10^{-4}$
	Zn−69		$2X10^{-2}$
Zirconium (40)	Zr−95		$6X10^{-4}$
	Zr−97		$2X10^{-4}$
Beta− and gamma−emitting radioactive material not listed above with half−life of less than 3 years.		$1X10^{-10}$	$1X10^{-6}$

Note 1: Many radionuclides transform into other radionuclides. In expressing the concentrations in Appendix A, the activity stated is that of the parent radionuclide and takes into account the radioactive decay products.

Note 2: For purposes of s. DHS 157.09 (2) where there is involved a combination of radionuclides, the limit for the combination should be derived as follows: Determine for each radionuclide in the product the ratio between the radioactivity concentration present in the product and the exempt radioactivity concentration established in Appendix A for the specific radionuclide when not in combination. The sum of such ratios may not exceed "1".

Example: $\frac{\text{Concentration of Radionuclide A in Product}}{\text{Exempt concentration of Radionuclide A}} + \frac{\text{Concentration of Radionuclide B in Product}}{\text{Exempt concentration of Radionuclide B}} \leq 1$

Note 3: To convert μCi/ml to SI units of megabecquerels per liter multiply the above values by 37.

Example: Zirconium (40) Zr−97 (2×10^{-4} μCi/ml multiplied by 37 is equivalent to 74×10^{-4} MBq/l).

1/ Values are given in Column I only for those materials normally used as gases.

2/ μCi/g for solids.

SECTION 98. DHS 157 Appendix B is repealed and recreated to read:

Chapter DHS 157
APPENDIX B

Exempt Quantities

Radioactive Material	Microcuries
Antimony−122 (Sb 122)	100
Antimony−124 (Sb 124)	10
Antimony−125 (Sb 125)	10
Arsenic−73 (As 73)	100
Arsenic−74 (As 74)	10
Arsenic−76 (As 76)	10
Arsenic−77 (As 77)	100
Barium−131 (Ba 131)	10
Barium−133 (Ba 133)	10
Barium−140 (Ba 140)	10
Bismuth−210 (Bi 210)	1
Bromine−82 (Br 82)	10
Cadmium−109 (Cd 109)	10
Cadmium−115m (Cd 115m)	10
Cadmium−115 (Cd 115)	100
Calcium−45 (Ca 45)	10
Calcium−47 (Ca 47)	10
Carbon−14 (C 14)	100
Cerium−141 (Ce 141)	100
Cerium−143 (Ce 143)	100
Cerium−144 (Ce 144)	1
Cesium−129 (Cs 129)	100
Cesium−131 (Cs 131)	1,000
Cesium−134m (Cs 134m)	100
Cesium−134 (Cs 134)	1
Cesium−135 (Cs 135)	10
Cesium−136 (Cs 136)	10
Cesium−137 (Cs 137)	10
Chlorine−36 (Cl 36)	10
Chlorine−38 (Cl 38)	10
Chromium−51 (Cr 51)	1,000
Cobalt−57 (Co 57)	100
Cobalt−58m (Co 58m)	10
Cobalt−58 (Co 58)	10
Cobalt−60 (Co 60)	1
Copper−64 (Cu 64)	100
Dysprosium−165 (Dy 165)	10
Dysprosium−166 (Dy 166)	100
Erbium−169 (Er 169)	100
Erbium−171 (Er 171)	100
Europium−152 (Eu 152)9.2h	100
Europium−152 (Eu 152)13 yr	1
Europium−154 (Eu 154)	1
Europium−155 (Eu 155)	10
Fluorine−18 (F 18)	1,000
Gadolinium−153 (Gd 153)	10
Gadolinium−159 (Gd 159)	100
Gallium−67 (Ga 67)	100
Gallium−72 (Ga 72)	10
Germanium−68 (Ge 68)	10
Germanium−71 (Ge 71)	100
Gold−195 (Au 195)	10
Gold−198 (Au 198)	100
Gold−199 (Au 199)	100
Hafnium−181 (Hf 181)	10
Holmium−166 (Ho 166)	100
Hydrogen−3 (H 3)	1,000
Indium−111 (In 111)	100
Indium−113m (In 113m)	100
Indium−114m (In 114m)	10
Indium−115m (In 115m)	100
Indium−115 (In 115)	10
Iodine−123 (I 123)	100
Iodine−125 (I 125)	1
Iodine−126 (I 126)	1
Iodine−129 (I 129)	0.1
Iodine−131 (I 131)	1
Iodine−132 (I 132)	10
Iodine−133 (I 133)	1
Iodine−134 (I 134)	10
Iodine−135 (I 135)	10
Iridium−192 (Ir 192)	10
Iridium−194 (Ir 194)	100
Iron−52 (Fe 52)	10
Iron−55 (Fe 55)	100
Iron−59 (Fe 59)	10
Krypton−85 (Kr 85)	100
Krypton−87 (Kr 87)	10
Lanthanum−140 (La 140)	10
Lutetium−177 (Lu 177)	100
Manganese−52 (Mn 52)	10
Manganese−54 (Mn 54)	10
Manganese−56 (Mn 56)	10
Mercury−197m (Hg 197m)	100
Mercury−197 (Hg 197)	100
Mercury−203 (Hg 203)	10
Molybdenum−99 (Mo 99)	100
Neodymium−147 (Nd 147)	100
Neodymium−149 (Nd 149)	100
Nickel−59 (Ni 59)	100
Nickel−63 (Ni 63)	10
Nickel−65 (Ni 65)	100
Niobium−93m (Nb 93m)	10
Niobium−95 (Nb 95)	10
Niobium−97 (Nb 97)	10

Radioactive Material	Microcuries
Osmium–185 (Os 185)	10
Osmium–191m (Os 191m)	100
Osmium–191 (Os 191)	100
Osmium–193 (Os 193)	100
Palladium–103 (Pd 103)	100
Palladium–109 (Pd 109)	100
Phosphorus–32 (P 32)	10
Platinum–191 (Pt 191)	100
Platinum–193m (Pt 193m)	100
Platinum–193 (Pt 193)	100
Platinum–197m (Pt 197m)	100
Platinum–197 (Pt 197)	100
Polonium–210 (Po 210)	0.1
Potassium–42 (K 42)	10
Potassium–43 (K 43)	10
Praseodymium–142 (Pr 142)	100
Praseodymium–143 (Pr 143)	100
Promethium–147 (Pm 147)	10
Promethium–149 (Pm 149)	10
Rhenium–186 (Re 186)	100
Rhenium–188 (Re 188)	100
Rhodium–103m (Rh 103m)	100
Rhodium–105 (Rh 105)	100
Rubidium–81 (Rb 81)	10
Rubidium–86 (Rb 86)	10
Rubidium–87 (Rb 87)	10
Ruthenium–97 (Ru 97)	100
Ruthenium–103 (Ru 103)	10
Ruthenium–105 (Ru 105)	10
Ruthenium–106 (Ru 106)	1
Samarium–151 (Sm 151)	10
Samarium–153 (Sm 153)	100
Scandium–46 (Sc 46)	10
Scandium–47 (Sc 47)	100
Scandium–48 (Sc 48)	10
Selenium–75 (Se 75)	10
Silicon–31 (Si 31)	100
Silver–105 (Ag 105)	10
Silver–110m (Ag 110m)	1
Silver–111 (Ag 111)	100
Sodium–22 (Na 22)	10
Sodium–24 (Na 24)	10
Strontium–85 (Sr 85)	10
Strontium–89 (Sr 89)	1
Strontium–90 (Sr 90)	0.1
Strontium–91 (Sr 91)	10
Strontium–92 (Sr 92)	10
Sulphur–35 (S 35)	100
Tantalum–182 (Ta 182)	10
Technetium–96 (Tc 96)	10
Technetium–97m (Tc 97m)	100
Technetium–97 (Tc 97)	100
Technetium–99m (Tc 99m)	100
Technetium–99 (Tc 99)	10
Tellurium–125m (Te 125m)	10
Tellurium–127m (Te 127m)	10
Tellurium–127 (Te 127)	100
Tellurium–129m (Te 129m)	10
Tellurium–129 (Te 129)	100
Tellurium–131m (Te 131m)	10
Tellurium–132 (Te 132)	10
Terbium–160 (Tb 160)	10
Thallium–200 (Tl 200)	100
Thallium–201 (Tl 201)	100
Thallium–202 (Tl 202)	100
Thallium–204 (Tl 204)	10
Thulium–170 (Tm 170)	10
Thulium–171 (Tm 171)	10
Tin–113 (Sn 113)	10
Tin–125 (Sn 125)	10
Tungsten–181 (W 181)	10
Tungsten–185 (W 185)	10
Tungsten–187 (W 187)	100
Vanadium–48 (V 48)	10
Xenon–131m (Xe 131m)	1,000
Xenon–133 (Xe 133)	100
Xenon–135 (Xe 135)	100
Ytterbium–175 (Yb 175)	100
Yttrium–87 (Y 87)	10
Yttrium–88 (Y 88)	10
Yttrium–90 (Y 90)	10
Yttrium–91 (Y 91)	10
Yttrium–92 (Y 92)	100
Yttrium–93 (Y 93)	100
Zinc–65 (Zn 65)	10
Zinc–69m (Zn 69m)	100
Zinc–69 (Zn 69)	1,000
Zirconium–93 (Zr 93)	10
Zirconium–95 (Zr 95)	10
Zirconium–97 (Zr 97)	10
Any radioactive material not listed above other than alpha-emitting radioactive material	0.1
Any alpha–emitting radioactive material not listed above other than transuranic radioactive material	0.01

Note 1:

To convert microcuries (µCi) to SI units of kilobecquerels (kBq), multiply the above values by 37.
Example: Zirconium–97 (10 µCi multiplied by 37 is equivalent to 370 kBq).

SECTION 99. DHS 157 Appendix E is repealed and recreated to read:

Chapter DHS 157
APPENDIX E

Annual Limits on Intake (ALI) and Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sanitary Sewerage

Introduction

For each radionuclide, Table I indicates the chemical form which is to be used for selecting the appropriate ALI or DAC value. The ALIs and DACs for inhalation are given for an aerosol with an activity median aerodynamic diameter (AMAD) of 1 μ(micron), and for the D, W and Y classes of radioactive material, which refer to their retention in the pulmonary region of the lung. This classification applies to a range of clearance half−times for D if less than 10 days, for W from 10 to 100 days, and for Y greater than 100 days. The D, W or Y class given in the column headed "Class" applies only to the inhalation ALIs and DACs given in Table I, column 2 and 3. Table II provides concentration limits for airborne and liquid effluents released to the general environment. Table III provides concentration limits for discharges to sanitary sewerage.

Note: The values in Tables I, II, and III are presented in the computer "E" notation. In this notation a value of 6E−02 represents a value of 6×10^{-2} or 0.06, 6E+2 represents 6 x $1O^2$ or 600, and 6E+0 represents 6×10^0 or 6.

Table I "Occupational Values"

Note that the columns in Table I of this appendix captioned "Oral Ingestion ALI," "Inhalation ALI" and "DAC" are applicable to occupational exposure to radioactive material. The ALIs in this appendix are the annual intakes of given radionuclide by "reference man" which would result in either (1) a committed effective dose equivalent of 0.05 Sv (5 rem), stochastic ALI, or (2) a committed dose equivalent of 0.5 Sv (50 rem) to an organ or tissue, non−stochastic ALI. The stochastic ALIs were derived to result in a risk, due to irradiation of organs and tissues, comparable to the risk associated with deep dose equivalent to the whole body of 0.05 Sv (5 rem). The derivation includes multiplying the committed dose equivalent to an organ or tissue by a weighting factor, w_T. This weighting factor is the proportion of the risk of stochastic effects resulting from irradiation of the organ or tissue, T, to the total risk of stochastic effects when the whole body is irradiated uniformly. The values of w_T are listed under the definition of weighting factor in s. DHS 157.03. The non−stochastic ALIs were derived to avoid non−stochastic effects, such as prompt damage to tissue or reduction in organ function.

Note: A description of the reference man is contained in the International Commission on Radiological Protection report, ICRP Publication 23, Reference Man: Anatomical Physiological and Metabolic Characteristics, Pergamon Press, Oxford (1975). The publication may be ordered from the web−site http://www.icrp.org/publications.asp.

A value of $w_T = 0.06$ is applicable to each of the 5 organs or tissues in the "remainder" category receiving the highest dose equivalents, and the dose equivalents of all other remaining tissues may be disregarded. The following portions of the GI tract -stomach, small intestine, upper large intestine, and lower large intestine - are to be treated as 4 separate organs. Note that the dose equivalents for an extremity, skin and lens of the eye are not considered in computing the committed effective dose equivalent, but are subject to limits that must be met separately.

When an ALI is defined by the stochastic dose limit, this value alone is given. When an ALI is determined by the non−stochastic dose limit to an organ, the organ or tissue to which the limit applies is shown, and the ALI for the stochastic limit is shown in parentheses.

Abbreviated organ or tissue designations are used:

LLI wall = lower large intestine wall;
St wall = stomach wall;
Blad wall = bladder wall; and
Bone surf = bone surface.

The use of the ALIs listed first, the more limiting of the stochastic and non−stochastic ALIs, will ensure that non−stochastic effects are avoided and that the risk of stochastic effects is limited to an acceptably low value. If, in a particular situation involving a radionuclide for which the non−stochastic ALI is limiting, use of that non−stochastic ALI is considered unduly conservative, the licensee may use the stochastic ALI to determine the committed effective dose equivalent. However, the licensee shall also ensure that the 0.5 Sv (50 rem) dose equivalent limit for any organ or tissue is not exceeded by the sum of the external deep dose equivalent plus the internal committed dose equivalent to that organ, not the effective dose. For the case where there is no external dose contribution, this would be demonstrated if the sum of the fractions of the nonstochastic ALIs that contribute to the committed dose equivalent to the organ receiving the highest dose does not exceed unity, that is, intake of each radionuclide/ALI_{ns} $=\leq 1.0$. If there is an external deep dose equivalent contribution of H_d, then this sum must be less than $1 - (H_d/50)$, instead of $=\leq 1.0$.

The derived air concentration (DAC) values are derived limits intended to control chronic occupational exposures. The relationship between the DAC and the ALI is given by: DAC = ALI-(μCi) /(2000 hours per working year x 60 minutes/ hour x 2 x 10^4 ml per minute) = [ALI/2.4 x 10^9] μCi/ml.

where 2 x 10^4 ml is the volume of air breathed per minute at work by reference man under working conditions of light work.
The DAC values relate to 1 of 2 modes of exposure: either external submersion or the internal committed dose equivalents resulting from inhalation of radioactive materials. DACs based upon submersion are for immersion in a semi−infinite cloud of uniform concentration and apply to each radionuclide separately. The ALI and DAC values include contributions to exposure by the single radionuclide named and any in−growth of daughter radionuclides produced in the body by decay of the parent. However, intakes that include both the parent and daughter radionuclides should be treated by the general method appropriate for mixtures.

The values of ALI and DAC do not apply directly when the individual both ingests and inhales a radionuclide, when the individual is exposed to a mixture of radionuclides by either inhalation or ingestion or both or when the individual is exposed to both internal and external irradiation. See s. DHS 157.22 (2). When an individual is exposed to radioactive materials that fall under several of the translocation classifications of the same radionuclide, such as Class D, Class W or Class Y, the exposure may be evaluated as if it were a mixture of different radionuclides.

It should be noted that the classification of a compound as Class D, W, or Y is based on the chemical form of the compound and does not take into account the radiological half−life of different radionuclides. For this reason, values are given for Class D, W, and Y compounds, even for very short−lived radionuclides.

Table II "Effluent Concentrations"
The columns in Table II of this appendix captioned "Effluents," "Air" and "Water" are applicable to the assessment and control of dose to the public, particularly in the implementation of the provisions of s. DHS 157.23 (2). The concentration values given in Columns 1 and 2 of Table II are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.5 mSv (0.05 rem).

Consideration of non−stochastic limits has not been included in deriving the air and water effluent concentration limits because non−stochastic effects are presumed not to occur at or below the dose levels established for individual members of the public. For radionuclides, where the non−stochastic limit was governing in deriving the occupational DAC, the stochastic ALI was used in deriving the corresponding airborne effluent limit in Table II. For this reason, the DAC and airborne effluent limits are not always proportional.

The air concentration values listed in Table II, Column 1 were derived by one of 2 methods. For those radionuclides for which the stochastic limit is governing, the occupational stochastic inhalation ALI was divided by 2.4 x 10^9 ml, relating the inhalation ALI to the DAC, as explained above, and then divided by a factor of 300. The factor of 300 includes the following components: a factor of 50 to relate the 0.05 Sv (5 rem) annual occupational dose limit to the 1 mSv (0.1 rem) limit for members of the public, a factor of 3 to adjust for the difference in exposure time and the inhalation rate for a worker and that for members of the public; and a factor of 2 to adjust the occupational values, derived for adults, so that they are applicable to other age groups.

For those radionuclides for which submersion, that is external dose, is limiting, the occupational DAC in Table I, Column 3 was divided by 219. The factor of 219 is composed of a factor of 50, as described above, and a factor of 4.38 relating occupational exposure for 2,000 hours of a 8,760 hour full−time exposure per year. Note that an additional factor of 2 for age considerations is not warranted in the submersion case.

The water concentrations were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3 x 10^7. The factor of 7.3 x 10^7 ml includes the following components: the factors of 50 and 2 described above and a factor of 7.3 x 10^5 ml which is the annual water intake of reference man.

Note 2 of this appendix provides groupings of radionuclides which are applicable to unknown mixtures of radionuclides. These groupings, including occupational inhalation ALIs and DACs, air and water effluent concentrations and releases to sewer, require demonstrating that the most limiting radionuclides in successive classes are absent. The limit for the unknown mixture is defined when the presence of one of the listed radionuclides cannot be definitely excluded as being present either from knowledge of the radionuclide composition of the source or from actual measurements.

Table III "Releases to Sewers"

The monthly average concentrations for release to sanitary sewerage are applicable to the provisions in s. DHS 157.30 (3). The concentration values were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3 x 10^6 ml. The factor of 7.3 x 10^6 ml is composed of a factor of 7.3 x 10^5 ml, the annual water intake by reference man, and a factor of 10, such that the concentrations, if the sewage released by the licensee were the only source of water ingested by a reference man during a year, would result in a committed effective dose equivalent of 5 mSv (0.5 rem).

List of Elements

Name	Symbol	Atomic Number
Actinium	Ac	89
Aluminum	A	13
Americium	Am	95
Antimony	Sb	51
Argon	Ar	18
Arsenic	As	33
Astatine	At	85
Barium	Ba	56
Berkelium	Bk	97
Beryllium	Be	4
Bismuth	Bi	83
Bromine	Br	35
Cadmium	Cd	48
Calcium	Ca	20
Californium	Cf	98
Carbon	C	6
Cerium	Ce	58
Cesium	Cs	55
Chlorine	Cl	17
Chromium	Cr	24
Cobalt	Co	27
Copper	Cu	29
Curium	Cm	96
Dysprosium	Dy	66
Einsteinium	Es	99
Erbium	Er	68
Europium	Eu	63
Fermium	Fm	100
Fluorine	F	9
Francium	Fr	87
Gadolinium	Gd	64
Gallium	Ga	31
Germanium	Ge	32
Gold	Au	79
Hafnium	Hf	72
Holmium	Ho	67
Hydrogen	H	1
Indium	In	49
Iodine	I	53
Iridium	Ir	77
Iron	Fe	26
Krypton	Kr	36
Lanthanum	La	57
Lead	Pb	82
Lutetium	Lu	71
Magnesium	Mg	12
Manganese	Mn	25
Mendelevium	Md	101

List of Elements (Cont.)

Name	Symbol	Atomic Number
Mercury	Hg	80
Molybdenum	Mo	42
Neodymium	Nd	60
Neptunium	Np	93
Nickel	Ni	28
Niobium	Nb	41
Nitrogen	N	7
Osmium	Os	76
Oxygen	O	8
Palladium	Pd	46
Phosphorus	P	15
Platinum	Pt	78
Plutonium	Pu	94
Polonium	Po	84
Potassium	K	19
Praseodymium	Pr	59
Promethium	Pm	61
Protactinium	Pa	91
Radium	Ra	88
Radon	Rn	86
Rhenium	Re	75
Rhodium	Rh	45
Rubidium	Rb	37
Ruthenium	Ru	44
Samarium	Sm	62
Scandium	Sc	21
Selenium	Se	34
Silicon	Si	14
Silver	Ag	47
Sodium	Na	11
Strontium	Sr	38
Sulfur	S	16
Tantalum	Ta	73
Technetium	Tc	43
Tellurium	Te	52
Terbium	Tv	65
Thallium	Tl	81
Thorium	Th	90
Thulium	Tm	69
Tin	Sn	50
Titanium	Ti	22
Tungsten	W	74
Uranium	U	92
Vanadium	V	23
Xenon	Xe	54
Ytterbium	Yb	70
Yttrium	Y	39
Zinc	Zn	30

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
1	Hydrogen−3	Water, DAC includes skin absorption	8E+4	8E+4	2E−5	1E−7	1E−3	1E−2
		Gas (HT or T_2) Submersion[a/]:	Use above values as HT & T_2 oxidize in air & in the body to HTO.					
4	Beryllium−7	4 W, all compounds except those given for Y	4E+4	2E+4	9E−6	3E−8	6E−4	6E−3
		Y, oxides, halides, and nitrates	−	2E+4	8E−6	3E−8	−	−
4	Beryllium−10	W, see ^{7}Be	1E+3	2E+2	6E−8	2E−10	−	−
			LLI wall (1E+3)	−	−	−	2E−5	2E−5
		Y, see ^{7}Be	−	1E+1	6E−9	2E−11	−	−
6	Carbon−11[b/]	Monoxide	−	1E+6	5E−4	2E−6	−	−
		Dioxide	−	6E+5	3E−4	9E−7	−	−
		Compounds	4E+5	4E+5	2E−4	6E−7	6E−3	6E−2
6	Carbon−14	Monoxide	−	2E+6	7E−4	2E−6	−	−
		Dioxide	−	2E+5	9E−5	3E−7	−	−
		Compounds	2E+3	2E+3	1E-6	3E-9	3E-5	3E-4
7	Nitrogen−13[b]	Submersion[a]		4E−6	2E−8			
8	Oxygen−15[b]	Submersion[a]		4E−6	2E−8			
9	Fluorine-18[b/]	D, fluorides of H, Li, Na, K, Rb, Cs, and Fr	5E+4	7E+4	3E−5	1E−7	−	−
			St wall (5E+4)	−	−	−	7E−4	7E−3
		W, fluorides of Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, As, Sb, Bi, Fe, Ru, Os, Co, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, V, Nb, Ta, Mn, Tc, and Re	−	9E+4	4E−5	1E−7	−	−
		Y, lanthanum fluoride	−	8E+4	3E−5	1E−7	−	−
11	Sodium−22	D, all compounds	4E+2	6E+2	3E−7	9E−10	6E−6	6E−5
11	Sodium−24	D, all compounds	4E+3	5E+3	2E−6	7E−9	5E−5	5E-4
12	Magnesium−28	D, all compounds except those given for W	7E+2	2E+3	7E−7	2E−9	9E−6	9E−5
		W, oxides, hydroxides, carbides, halides, and nitrates	−	1E+3	5E−7	2E−9	−	−
13	Aluminum−26	D, all compounds except those given for W	4E+2	6E+1	3E−8	9E−11	6E−6	6E−5
		W, oxides, hydroxides, carbides, halides, and nitrates	−	9E+1	4E−8	1E−10	−	−
14	Silicon−31	D, all compounds except those given for W and Y	9E+3	3E+4	1E−5	4E−8	1E−4	1E−3
		W, oxides, hydroxides,= carbides, and nitrates	−	3E+4	1E−5	5E−8	−	−
		Y, aluminosilicate glass	−	3E+4	1E−5	4E−8	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
14	Silicon-32	D, see ^{31}Si	2E+3	2E+2	1E−7	3E−10	−	−
			LLI wall (3E+3)	−	−	−	4E−5	4E−4
		W, see ^{31}Si	−	1E+2	5E-8	2E-10	−	−
		Y, see ^{31}Si	−	5E+0	2E-9	7E-12	−	−
15	Phosphorus−32	D, all compounds except phosphates given for W	6E+2	9E+2	4E−7	1E−9	9E−6	9E−5
		W, phosphates of Zn^{2+}, S^{3+}, Mg^{2+}, Fe^{3+}, Bi^{3+}, and lanthanides	−	4E+2	2E−7	5E−10	−	−
15	Phosphorus−33	D, see ^{32}P	6E+3	8E+3	4E−6	1E−8	8E−5	8E−4
		W, see ^{32}P	−	3E+3	1E−6	4E−9	−	−
16	Sulfur−35	Vapor	−	1E+4	6E−6	2E−8	−	−
		D, sulfides and sulfates except those given for W	1E+4	2E+4	7E−6	2E−8	−	−
			LLI wall (8E+3)	−	−	−	1E−4	1E−3
		W, elemental sulfur sulfides of Sr, Ba, Ge, Sn, Pb, As, Sb, Bi, Cu, Ag, Au, Zn, Cd, Hg, W, and Mo. Sulfates of Ca, Sr, Ba, Ra, As, Sb, and Bi	6E+3	−	2E+3	9E−7	3E−9	−
17	Chlorine−36	D, chlorides of H, Li, Na, K, Rb, Cs, and Fr	2E+3	2E+3	1E−6	3E−9	2E−5	2E−4
		W, chlorides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, and Re	−	2E+2	1E−7	3E−10	−	−
17	Chlorine−38[b/]	D, see ^{36}Cl	2E+4	4E+4	6E−8	6E−8	−	−
			St wall (3E+4)	−	−	−	3E−4	3E−3
		W, see ^{36}Cl	−	5E+4	2E−5	6E−8	−	−
17	Chlorine−39[b/]	D, see ^{36}Cl	2E+4	5E+4	2E−5	7E−8	−	−
			St wall (4E+4)	−	−	−	5E−4	5E−3
		W, see 36Cl	−	6E+4	2E−5	8E−8	−	−
18	Argon−37	Submersion[a/]	−	−	1E+0	6E−3	−	−
18	Argon−39	Submersion[a/]	−	−	2E−4	8E−7	−	−
18	Argon−41	Submersion[a/]	−	−	3E−6	1E−8	−	−
19	Potassium−40	D, all compounds	3E+2	4E+2	2E−7	6E−10	4E−6	4E−5
19	Potassium−42	D, all compounds	5E+3	5E+3	2E−6	7E−9	6E−5	6E−4
19	Potassium−43	D, all compounds	6E+3	9E+3	4E−6	1E−8	9E−5	9E−4

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
19	Potassium−44[b/]	D, all compounds	2E+4	7E+4	3E-5	9E-8	−	−
			St wall (4E+4)	−	−	−	5E−4	5E−3
19	Potassium−45[b/]	D, all compounds	3E+4	1E+5	5E−5	2E−7	−	−
			St wall (5E+4)	−	−	−	7E−4	7E−3
20	Calcium−41	W, all compounds	3E+3	4E+3	2E−6	−	−	−
			Bone surf (4E+3)	Bone surf (4E+3)	−	5E−9	6E−5	6E−4
20	Calcium−45	W, all compounds	2E+3	8E+2	4E−7	1E−9	2E−5	2E−4
20	Calcium−47	W, all compounds	8E+2	9E+2	4E−7	1E−9	1E−5	1E−4
21	Scandium−43	Y, all compounds	7E+3	2E+4	9E−6	3E−8	1E−4	1E−3
21	Scandium−44m	Y, all compounds	5E+2	7E+2	3E−7	1E−9	7E−6	7E−5
21	Scandium−44	Y, all compounds	4E+3	1E+4	5E−6	2E−8	5E−5	5E−4
21	Scandium−46	Y, all compounds	9E+2	2E+2	1E−7	3E−10	1E−5	1E−4
21	Scandium−47	Y, all compounds	2E+3	3E+3	1E−6	4E−9	−	−
			LLI wall (3E+3)	−	−	−	4E−5	4E−4
21	Scandium−48	Y, all compounds	8E+2	1E+3	6E−7	2E−9	1E−5	1E−4
21	Scandium−49[b/]	Y, all compounds	2E+4	5E+4	2E−5	8E−8	3E−4	3E−3
22	Titanium−44	D, all compounds except those given for W and Y	3E+2	1E+1	5E−9	2E−11	4E−6	4E−5
		W, oxides, hydroxides, carbides, halides, and nitrates	−	3E+1	1E−8	4E−11	−	−
		Y, SrTi0	−	6E+0	2E−9	8E−12	−	−
22	Titanium−45	D, see ^{44}Ti	9E+3	3E+4	1E−5	3E−8	1E−4	1E−3
		W, see ^{44}Ti	−	4E+4	1E−5	5E−8	−	−
		Y, see ^{44}Ti	−	3E+4	1E−5	4E−8	−	−
23	Vanadium−47[b/]	D, all compounds except those given for W	3E+4	8E+4	3E−5	1E−7	−	−
			St wall (3E+4)	−	−	−	4E−4	4E−3
		W, oxides, hydroxides, carbides, and halides	−	1E+5	4E−5	1E−7	−	−
23	Vanadium−48	D, see ^{47}V	6E+2	1E+3	5E−7	2E−9	9E−6	9E−5
		W, see ^{47}V	−	6E+2	3E−7	9E−10	−	−
23	Vanadium−49	D, see ^{47}V	7E+4	3E+4	1E−5	−	−	−
			LLI wall (9E+4)	Bone surf (3E+4)	−	5E−8	1E−3	1E−2
		W, see ^{47}V	−	2E+4	8E−6	2E−8	−	−
24	Chromium−48	D, all compounds except those given for W and Y	6E+3	1E+4	5E−6	2E−8	8E−5	8E−4
		W, halides and nitrates	−	7E+3	3E−6	1E−8	−	−
		Y, oxides and hydroxides	−	7E+3	3E−6	1E−8	−	−
24	Chromium−49[b/]	D, see ^{48}Cr	3E+4	8E+4	4E−5	1E−7	4E−4	4E−3
		W, see ^{48}Cr	−	1E+5	4E−5	1E−7	−	−
		Y, see ^{48}Cr	−	9E+4	4E−5	1E−7	−	−
24	Chromium−51	D, see ^{48}Cr	4E+4	5E+4	2E−5	6E−8	5E−4	5E−3
		W, see ^{48}Cr	−	2E+4	1E−5	3E−8	−	−
		Y, see ^{48}Cr	−	2E+4	8E−6	3E−8	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
25	Manganese−51[b/]	D, all compounds except those given for W	2E+4	5E+4	2E-5	7E-8	3E−4	3E−3
		W, oxides, hydroxides, halides, and nitrates	–	6E+4	3E−5	8E−8	–	–
25	Manganese−52m[b/]	D, see ^{51}Mn	3E+4	9E+4	4E−5	1E−7	–	–
			St wall (4E+4)	–	–	–	5E−4	5E−3
		W, see ^{51}Mn	–	1E+5	4E−5	1E−7	–	–
25	Manganese−52	D, see ^{51}Mn	7E+2	1E+3	5E−7	2E−9	1E−5	1E−4
		W, see ^{51}Mn	–	9E+2	4E−7	1E−9	–	–
25	Manganese−53	D, see ^{51}Mn	5E+4	1E+4	5E−6	–	7E−4	7E−3
			–	Bone surf (2E+4)	–	3E−8	–	–
		W, see ^{51}Mn	–	1E+4	5E−6	2E−8	–	–
25	Manganese−54	D, see ^{51}Mn	2E+3	9E+2	4E−7	1E−9	3E−5	3E−4
		W, see ^{51}Mn	–	8E+2	3E−7	1E−9	–	–
25	Manganese−56	D, see ^{51}Mn	5E+3	2E+4	6E−6	2E−8	7E−5	7E−4
		W, see ^{51}Mn	–	2E+4	9E−6	3E−8	–	–
26	Iron−52	D, all compounds except those given for W	9E+2	3E+3	1E−6	4E−9	1E−5	1E−4
		W, oxides, hydroxides, and halides	–	2E+3	1E−6	3E−9	–	–
26	Iron−55	D, see ^{52}Fe	9E+3	2E+3	8E−7	3E−9	1E−4	1E−3
		W, see ^{52}Fe	–	4E+3	2E−6	6E−9	–	–
26	Iron−59	D, see ^{52}Fe	8E+2	3E+2	1E−7	5E−10	1E−5	1E−4
		W, see ^{52}Fe	–	5E+2	2E−7	7E−10	–	–
26	Iron-60	D, see ^{52}Fe	3E+1	6E+0	3E−9	9E−12	4E−7	4E−6
		W, see ^{52}Fe	–	2E+1	8E−9	3E−11	–	–
27	Cobalt−55	W, all compounds except those given for Y	1E+3	3E+3	1E−6	4E−9	2E−5	2E−4
		Y, oxides, hydroxides, halides, and nitrates	–	3E+3	1E−6	4E−9	–	–
27	Cobalt−56	W, see ^{55}Co	5E+2	3E+2	1E−7	4E−10	6E−6	6E−5
		Y, see ^{55}Co	4E+2	2E+2	8E−8	3E−10	–	–
27	Cobalt−57	W, see ^{55}Co	8E+3	3E+3	1E−6	4E−9	6E−5	6E−4
		Y, see ^{55}Co	4E+3	7E+2	3E−7	9E−10	–	–
27	Cobalt−58m	W, see ^{55}Co	6E+4	9E+4	4E−5	1E−7	8E−4	8E−3
		Y, see ^{55}Co	–	6E+4	3E−5	9E−8	–	–
27	Cobalt−58	W, see ^{55}Co	2E+3	1E+3	5E−7	2E−9	2E−5	2E−4
		Y, see ^{55}Co	1E+3	7E+2	3E−7	1E−9	–	–
27	Cobalt−60m[b/]	W, see ^{55}Co	1E+6	4E+6	2E−3	6E−6	–	–
			St wall (1E+6)	–	–	–	2E−2	2E−1
		Y, see ^{55}Co	–	3E+6	1E−3	4E−6	–	–
27	Cobalt−60	W, see ^{55}Co	5E+2	2E+2	7E−8	2E−10	3E−6	3E−5
		Y, see ^{55}Co	2E+2	3E+1	1E−8	5E−11	–	–
27	Cobalt−61[b/]	W, see ^{55}Co	2E+4	6E+4	3E−5	9E−8	3E−4	3E−3
		Y, see ^{55}Co	2E+4	6E+4	2E−5	8E−8	–	–

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
27	Cobalt−62m[b/]	W, see ^{55}Co	4E+4	2E+5	7E-5	2E-7	–	–
			St wall (5E+4)	–	–	–	7E−4	7E−3
		Y, see ^{55}Co	–	2E+5	6E-5	2E-7	–	–
28	Nickel−56	D, all compounds except those given for W	1E+3	2E+3	8E−7	3E−9	2E−5	2E−4
		W, oxides, hydroxides, and carbides	–	1E+3	5E−7	2E−9	–	–
		Vapor	–	1E+3	5E−7	2E−9	–	–
28	Nickel−57	D, see ^{56}Ni	2E+3	5E+3	2E−6	7E−9	2E−5	2E−4
		W, see ^{56}Ni	–	3E+3	1E−6	4E−9	–	–
		Vapor	–	6E+3	3E−6	9E−9	–	–
28	Nickel−59	D, see ^{56}Ni	2E+4	4E+3	2E−6	5E−9	3E−4	3E−3
		W, see ^{56}Ni	–	7E+3	3E−6	1E−6	–	–
		Vapor	–	E+3	8E−7	3E−9	–	–
28	Nickel−63	D, see ^{56}Ni	9E+3	2E+3	7E−7	2E−9	1E−4	1E−3
		W, see ^{56}Ni	–	3E+3	1E−6	4E−9	–	–
		Vapor	–	8E+2	3E−7	1E−9	–	–
28	Nickel−65	D, see ^{56}Ni	8E+3	2E+4	1E−5	3E−8	1E−4	1E−3
		W, see ^{56}Ni	–	3E+4	1E−5	4E−8	–	–
		Vapor	–	2E+4	7E−6	2E−8	–	–
28	Nickel−66	D, see ^{56}Ni	4E+2	2E+3	7E−7	2E−9	–	–
			LLI wall (5E+2)	–	–	–	6E−6	6E−5
		W, see ^{56}Ni	–	6E+2	3E−7	9E−10	–	–
		Vapor	–	3E+3	1E−6	4E−9	–	–
29	Copper−60[b/]	D, all compounds except those given for W and Y	3E+4	9E+4	4E−5	1E−7	–	–
			St wall (3E+4)	–	–	–	4E−4	4E−3
		W, sulfides, halides, and nitrates	–	1E+5	5E−5	2E−7	–	–
		Y, oxides and hydroxides	–	1E+5	4E−5	1E−7	–	–
29	Copper−61	D, see ^{60}Cu	1E+4	3E+4	1E−5	4E−8	2E−4	2E−3
		W, see ^{60}Cu	–	4E+4	2E−5	6E−8	–	–
		Y, see ^{60}Cu	–	4E+4	1E−5	5E−8	–	–
29	Copper−64	D, see ^{60}Cu	1E+4	3E+4	1E−5	4E−8	2E−4	2E−3
		W, see ^{60}Cu	–	2E+4	1E−5	3E−8	–	–
		Y, see ^{60}Cu	–	2E+4	9E−6	3E−8	–	–
29	Copper−67	D, see ^{60}Cu	5E+3	8E+3	3E−6	1E−8	6E−5	6E−4
		W, see ^{60}Cu	–	5E+3	2E−6	7E−9	–	–
		Y, see ^{60}Cu	–	5E+3	2E−6	6E−9	–	–
30	Zinc−62	Y, all compounds	1E+3	3E+3	1E−6	4E−9	2E−5	2E−4
30	Zinc−63[b/]	Y, all compounds	2E+4	7E+4	3E−5	9E−8	–	–
			St wall (3E+4)	–	–	–	3E−4	3E−3
30	Zinc−65	Y, all compounds	4E+2	3E+2	1E−7	4E−10	5E−6	5E−5
30	Zinc−69m	Y, all compounds	4E+3	7E+3	3E−6	1E−8	6E−5	6E−4
30	Zinc−69[b/]	Y, all compounds	6E+4	1E+5	6E−5	2E−7	8E−4	8E−3
30	Zinc−71m	Y, all compounds	6E+3	2E+4	7E−6	2E−8	8E−5	8E−4

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
30	Zinc−72	Y, all compounds	1E+3	1E+3	5E−7	2E−9	1E−5	1E−4
31	Gallium−65[b/]	D, all compounds except those given for W	5E+4	2E+5	7E−5	2E−7	−	−
			St wall (6E+4)	−	−	−	9E−4	9E−3
		W, oxides, hydroxides, carbides, halides, and nitrates	−	2E+5	8E−5	3E−7	−	−
31	Gallium−66	D, see ^{65}Ga	1E+3	4E+3	1E−6	5E−9	1E−5	1E−4
		W, see ^{65}Ga	−	3E+3	1E−6	4E−9	−	−
31	Gallium−67	D, see ^{65}Ga	7E+3	1E+4	6E−6	2E−8	1E−4	1E−3
		W, see ^{65}Ga	−	1E+4	4E−6	1E−8	−	−
31	Gallium−68[b/]	D, see ^{65}Ga	2E+4	4E+4	2E−5	6E−8	2E−4	2E−3
		W, see ^{65}Ga	−	5E+4	2E−5	7E−8	−	−
31	Gallium−70b/	D, see ^{65}Ga	5E+4	2E+5	7E−5	2E−7	−	−
			St wall (7E+4)	−	−	−	1E−3	1E−2
		W, see 65Ga	−	2E+5	8E−5	3E−7	−	−
31	Gallium−72	D, see ^{65}Ga	1E+3	4E+3	1E−6	5E−9	2E−5	2E−4
		W, see ^{65}Ga	−	3E+3	1E−6	4E−9	−	−
31	Gallium−73	D, see ^{65}Ga	5E+3	2E+4	6E−6	2E−8	7E−5	7E−4
		W, see ^{65}Ga	−	2E+4	6E−6	2E−8	−	−
32	Germanium−66	D, all compounds except those given for W	2E+4	3E+4	1E−5	4E−8	3E−4	3E−3
		W, oxides, sulfides, and halides	−	2E+4	8E−6	3E−8	−	−
32	Germanium−67[b/]	D, see ^{66}Ge	3E+4	9E+4	4E−5	1E−7	−	−
			St wall (4E+4)	−	−	−	6E−4	6E−3
		W, see ^{66}Ge	−	1E+5	4E−5	1E−7	−	−
32	Germanium−68	D, see ^{66}Ge	5E+3	4E+3	2E−6	5E−9	6E−5	6E−4
		W, see ^{66}Ge	−	1E+2	4E−8	1E−10	−	−
32	Germanium−69	D, see ^{66}Ge	1E+4	2E+4	6E−6	2E−8	2E−4	2E−3
		W, see ^{66}Ge	−	8E+3	3E−6	1E−8	−	−
32	Germanium−71	D, see ^{66}Ge	5E+5	4E+5	2E−4	6E−7	7E−3	7E−2
		W, see ^{66}Ge	−	4E+4	2E−5	6E−8	−	−
32	Germanium−75[b/]	D, see ^{66}Ge	4E+4	8E+4	3E−5	1E−7	−	−
			St wall (7E+4)	−	−	−	9E−4	9E−3
		W, see ^{66}Ge	−	8E+4	4E−5	1E−7	−	−
32	Germanium−77	D, see ^{66}Ge	9E+3	1E+4	4E−6	1E−8	1E−4	1E−3
		W, see ^{66}Ge	−	6E+3	2E−6	8E−9	−	−
32	Germanium−78[b/]	D, see ^{66}Ge	2E+4	2E+4	9E−6	3E−8	−	−
			St wall (2E+4)	−	−	−	3E−4	3E−3
		W, see ^{66}Ge	−	2E+4	9E−6	3E−8	−	−
33	Arsenic−69[b/]	W, all compounds	3E+4	1E+5	5E−5	2E−7	−	−
			St wall (4E+4)	−	−	−	6E−4	6E−3
33	Arsenic−70[b/]	W, all compounds	1E+4	5E+4	2E−5	7E−8	2E−4	2E−3

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (µCi)	ALI (µCi)	DAC (µCi/ml)	Air (µCi/ml)	Water (µCi/ml)	Concentration (µCi/ml)
33	Arsenic−71	W, all compounds	4E+3	5E+3	2E−6	6E−9	5E−5	5E−4
33	Arsenic−72	W, all compounds	9E+2	1E+3	6E−7	2E−9	1E−5	1E−4
33	Arsenic−73	W, all compounds	8E+3	2E+3	7E−7	2E−9	1E−4	1E−3
33	Arsenic−74	W, all compounds	1E+3	8E+2	3E−7	1E−9	2E−5	2E−4
33	Arsenic−76	W, all compounds	1E+3	1E+3	6E−7	2E−9	1E−5	1E−4
33	Arsenic−77	W, all compounds	4E+3	5E+3	2E−6	7E−9	−	−
			LLI wall (5E+3)	−	−	−	6E−5	6E−4
33	Arsenic−78[b/]	W, all compounds	8E+3	2E+4	9E−6	3E−8	1E−4	1E−3
34	Selenium−70[b/]	D, all compounds except those given for W	2E+4	4E+4	2E−5	5E−8	1E−4	1E−3
		W, oxides, hydroxides, carbides, and elemental Se	1E+4	4E+4	2E−5	6E−8	−	−
34	Selenium−73m[b/]	D, see ^{70}Se	6E+4	2E+5	6E−5	2E−7	4E−4	4E−3
		W, see ^{70}Se	3E+4	1E+5	6E−5	2E−7	−	−
34	Selenium−73	D, see ^{70}Se	3E+3	1E+4	5E−6	2E−8	4E−5	4E−4
		W, see ^{70}Se	-	2E+4	7E−6	2E−8	−	−
34	Selenium−75	D, see ^{70}Se	5E+2	7E+2	3E−7	1E−9	7E−6	7E−5
		W, see ^{70}Se	−	6E+2	3E−7	8E−10	−	−
34	Selenium−79	D, see ^{70}Se	6E+2	8E+2	3E−7	1E−9	8E−6	8E−5
		W, see ^{70}Se	−	6E+2	2E−7	8E−10	−	−
34	Selenium−81m[b/]	D, see ^{70}Se	4E+4	7E+4	3E−5	9E−8	3E−4	3E−3
		W, see ^{70}Se	2E+4	7E+4	3E−5	1E−7	−	−
34	Selenium−81[b/]	D, see ^{70}Se	6E+4	2E+5	9E−5	3E−7	−	−
			St wall (8E+4)	−	−	−	1E−3	1E−2
		W, see ^{70}Se	−	2E+5	1E−4	3E−7	−	−
34	Selenium−83[b/]	D, see ^{70}Se	4E+4	1E+5	5E−5	2E−7	4E−4	4E−3
		W, see ^{70}Se	3E+4	1E+5	5E−5	2E−7	−	−
35	Bromine−74m[b/]	D, bromides of H, Li, Na, K, Rb, Cs, and Fr	1E+4	4E+4	2E−5	5E−8	−	−
			St wall (2E+4)	−	−	−	3E−4	3E−3
		W, bromides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Mn, Tc, and Re	−	4E+4	2E−5	6E−8	−	−
35	Bromine−74[b/]	D, see ^{74m}Br	2E+4	7E+4	3E−5	1E−7	−	−
			St wall (4E+4)	−	−	−	5E−4	5E−3
		W, see ^{74m}Br	−	8E+4	4E−5	1E−7	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
35	Bromine−75[b/]	D, see ^{74m}Br	3E+4	5E+4	2E−5	7E−8	−	−
			St wall (4E+4)	−	−	−	5E−4	5E−3
		W, see ^{74m}Br	−	5E+4	2E−5	7E−8	−	−
35	Bromine−76	D, see ^{74m}Br	4E+3	5E+3	2E−6	7E−9	5E−5	5E−4
		W, see ^{74m}Br	−	4E+3	2E−6	6E−9	−	−
35	Bromine−77	D, see ^{74m}Br	2E+4	2E+4	1E−5	3E−8	2E−4	2E−3
		W, see ^{74m}Br	−	2E+4	8E−6	3E−8	−	−
35	Bromine−80m	D, see ^{74m}Br	2E+4	2E+4	7E−6	2E−8	3E−4	3E−3
		W, see ^{74m}Br	−	1E+4	6E−6	2E−8	−	−
35	Bromine−80[b/]	D, see ^{74m}Br	5E+4	2E+5	8E−5	3E−7	−	−
			St wall (9E+4)	−	−	−	1E−3	1E−2
		W, see ^{74m}Br	−	2E+5	9E−5	3E−7	−	−
35	Bromine−82	D, see ^{74m}Br	3E+3	4E+3	2E−6	6E−9	4E−5	4E−4
		W, see ^{74m}Br	−	4E+3	2E−6	5E−9	−	−
35	Bromine−83	D, see ^{74m}Br	5E+4	6E+4	3E−5	9E−8	−	−
			St wall (7E+4)	−	−	−	9E−4	9E−3
		W, see ^{74m}Br	−	6E+4	3E−5	9E−8	−	−
35	Bromine−84[b/]	D, see ^{74m}Br	2E+4	6E+4	2E−5	8E−8	−	−
			St wall (3E+4)	−	−	−	4E−4	4E−3
		W, see ^{74m}Br	−	6E+4	3E−5	9E−8	−	−
36	Krypton−74[b/]	Submersion[a/]	−	−	3E-6	1E-8	−	−
36	Krypton−76	Submersion[a/]	−	−	9E-6	4E-8	−	−
36	Krypton−77[b/]	Submersion[a/]	−	−	4E-6	2E-8	−	−
36	Krypton−79	Submersion[a/]	−	−	2E-5	7E-8	−	−
36	Krypton−81	Submersion[a/]	−	−	7E-4	3E-6	−	−
36	Krypton−83m[b/]	Submersion[a/]	−	−	1E-2	5E-5	−	−
36	Krypton−85m	Submersion[a/]	−	−	2E-5	1E-7	−	−
36	Krypton−85	Submersion[a/]	−	−	1E-4	7E-7	−	−
36	Krypton−87[b/]	Submersion[a/]	−	−	5E-6	2E-8	−	−
36	Krypton−88	Submersion[a/]	−	−	2E-6	9E-9	−	−
37	Rubidium−79[b/]	D, all compounds	4E+4	1E+5	5E−5	2E−7	−	−
			St wall (6E+4)	−	−	−	8E−4	8E−3
37	Rubidium−81m[b/]	D, all compounds	2E+5	3E+5	1E−4	5E−7	−	−
			St wall (3E+5)	−	−	−	4E−3	4E−2
37	Rubidium−81	D, all compounds	4E+4	5E+4	2E−5	7E−8	5E−4	5E−3
37	Rubidium−82m	D, all compounds	1E+4	2E+4	7E−6	2E−8	2E−4	2E−3
37	Rubidium−83	D, all compounds	6E+2	1E+3	4E−7	1E−9	9E−6	9E−5
37	Rubidium−84	D, all compounds	5E+2	8E+2	3E−7	1E−9	7E−6	7E−5
37	Rubidium−86	D, all compounds	5E+2	8E+2	3E−7	1E−9	7E−6	7E−5
37	Rubidium−87	D, all compounds	1E+2	2E+3	6E−7	2E−9	1E−5	1E−4
37	Rubidium−88[b/]	D, all compounds	2E+4	6E+4	2E−5	9E−8	−	−
			St wall (3E+4)	−	−	−	4E−4	4E−3

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (µCi)	ALI (µCi)	DAC (µCi/ml)	Air (µCi/ml)	Water (µCi/ml)	Concentration (µCi/ml)
37	Rubidium−89[b/]	D, all compounds	4E+4	1E+5	6E−5	2E−7	−	−
			St wall (6E+4)	−	−	−	9E−4	9E−3
38	Strontium−80[b/]	D, all soluble compounds except $SrTiO_3$	4E+3	1E+4	5E−6	2E−8	6E−5	6E−4
		Y, all insoluble compounds and $SrTi0_3$	−	1E+4	5E−6	2E−8	−	−
38	Strontium−81[b/]	D, see ^{80}Sr	3E+4	8E+4	3E−5	1E−7	3E−4	3E−3
		Y, see ^{80}Sr	2E+4	8E+4	3E−5	1E−7	−	−
38	Strontium−82	D, see ^{80}Sr	3E+2	4E+2	2E−7	6E−10	−	−
			LLI wall (2E+2)	−	−	−	3E−6	3E−5
		Y, see ^{80}Sr	2E+2	9E+1	4E−8	1E−10	−	−
38	Strontium−83	D, see ^{80}Sr	3E+3	7E+3	3E−6	1E−8	3E−5	3E−4
		Y, see ^{80}Sr	2E+3	4E+3	1E−6	5E−9	−	−
38	Strontium−85m[b/]	D, see ^{80}Sr	2E+5	6E+5	3E−4	9E−7	3E−3	3E−2
		Y, see ^{80}Sr	−	8E+5	4E−4	1E−6	−	−
38	Strontium−85	D, see ^{80}Sr	3E+3	3E+3	1E−6	4E−9	4E−5	4E−4
		Y, see ^{80}Sr	−	2E+3	6E−7	2E−9	−	−
38	Strontium−87m	D, see ^{80}Sr	5E+4	1E+5	5E−5	2E−7	6E−4	6E−3
		Y, see ^{80}Sr	4E+4	2E+5	6E−5	2E−7	−	−
38	Strontium−89	D, see ^{80}Sr	6E+2	8E+2	4E−7	1E−9	−	−
			LLI wall (6E+2)	−	−	−	8E−6	8E−5
		Y, see ^{80}Sr	5E+2	1E+2	6E−8	2E−10	−	−
38	Strontium−90	D, see ^{80}Sr	3E+1	2E+1	8E−9		−	−
			Bone surf (4E+1)	Bone surf (2E+1)	−	3E−11	5E−7	5E−6
		Y, see ^{80}Sr	−	4E+0	2E−9	6E−12	−	−
38	Strontium−91	D, see ^{80}Sr	2E+3					
			6E+3	2E−6	8E−9	2E−5	2E−4	
		Y, see ^{80}Sr	−	4E+3	1E−6	5E−9	−	−
38	Strontium−92	D, see ^{80}Sr	3E+3	9E+3	4E−6	1E−8	4E−5	4E−4
		Y, see ^{80}Sr	−	7E+3	3E−6	9E−9	−	−
39	Yttrium−86m[b/]	W, all compounds except those given for Y	2E+4	6E+4	2E−5	8E−8	3E−4	3E−3
		Y, oxides and hydroxides	−	5E+4	2E−5	8E−8	−	−
39	Yttrium−86	W, see ^{86m}Y	1E+3	3E+3	1E−6	5E−9	2E−5	2E−4
		Y, see ^{86m}Y	−	3E+3	1E−6	5E−9	−	−
39	Yttrium−87	W, see ^{86m}Y	2E+3	3E+3	1E−6	5E−9	3E−5	3E−4
		Y, see ^{86m}Y	−	3E+3	1E−6	5E−9	−	−
39	Yttrium−88	W, see ^{86m}Y	1E+3	3E+2	1E−7	3E−10	1E−5	1E−4
		Y, see ^{86m}Y	−	2E+2	1E−7	3E−10	−	−
39	Yttrium−90m	W, see ^{86m}Y	8E+3	1E+4	5E−6	2E−8	1E−4	1E−3
		Y, see ^{86m}Y	−	1E+4	5E−6	2E−8	−	−
39	Yttrium−90	W, see ^{86m}Y	4E+2	7E+2	3E−7	9E−10	−	−
			LLI wall (5E+2)	−	−	−	7E−6	7E−5
		Y, see ^{86m}Y	−	6E+2	3E−7	9E−10	−	−

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
39	Yttrium−91m[b/]	W, see ^{86m}Y	1E+5	2E+5	1E−4	3E−7	2E−3	2E−2
		Y, see ^{86m}Y	−	2E+5	7E−5	2E−7	−	−
39	Yttrium−91	W, see ^{86m}Y	5E+2	2E+2	7E−8	2E−10	−	−
			LLI wall (6E+2)	−	−	−	8E−6	8E−5
		Y, see ^{86m}Y	−	1E+2	5E−8	2E−10	−	−
39	Yttrium−92	W, see ^{86m}Y	3E+3	9E+3	4E−6	1E−8	4E−5	4E−4
		Y, see ^{86m}Y	−	8E+3	3E−6	1E−8	−	−
39	Yttrium−93	W, see ^{86m}Y	1E+3	3E+3	1E−6	4E−9	2E−5	2E−4
		Y, see ^{86m}Y	−	2E+3	1E−6	3E−9	−	−
39	Yttrium−94[b/]	W, see ^{86m}Y	2E+4	8E+4	3E−5	1E−7	−	−
			St wall (3E+4)	−	−	−	4E−4	4E−3
		Y, see ^{86m}Y	−	8E+4	3E−5	1E−7	−	−
39	Yttrium−95[b/]	W, see ^{86m}Y	4E+4	2E+5	6E−5	2E−7	−	−
			St wall (5E+4)	−	−	−	7E−4	7E−3
		Y, see ^{86m}Y	−	1E+5	6E−5	2E−7	−	−
40	Zirconium−86	D, all compounds except those given for W and Y	1E+3	4E+3	2E−6	6E−9	2E−5	2E−4
		W, oxides, hydroxides, halides, and nitrates	−	3E+3	1E−6	4E−9	−	−
		Y, carbide	−	2E+3	1E−6	3E−9	−	−
40	Zirconium−88	D, see ^{86}Zr	4E+3	2E+2	9E−8	3E−10	5E−5	5E−4
		W, see ^{86}Zr	−	5E+2	2E−7	7E−10	−	−
		Y, see ^{86}Zr	−	3E+2	1E−7	4E−10	−	−
40	Zirconium−89	D, see ^{86}Zr	2E+3	4E+3	1E−6	5E−9	2E−5	2E−4
		W, see ^{86}Zr	−	2E+3	1E−6	3E−9	−	−
		Y, see ^{86}Zr	−	2E+3	1E−6	3E−9	−	−
40	Zirconium−93	D, see ^{86}Zr	1E+3	6E+0	3E−9	−	−	−
			Bone surf (3E+3)	Bone surf (2E+1)	−	2E−11	4E−5	4E−4
		W, see ^{86}Zr	−	2E+1	1E−8			
			−	Bone surf (6E+1)	−	9E−11	−	−
		Y, see ^{86}Zr	−	6E+1	2E−8	−	−	−
			−	Bone surf (7E+1)	−	9E−11	−	−
40	Zirconium−95	D, see ^{86}Zr	1E+3	1E+2	5E−8	−	2E−5	2E−4
			−	Bone surf (3E+2)	−	4E−10	−	−
		W, see ^{86}Zr	−	4E+2	2E−7	5E−10	−	−
		Y, see ^{86}Zr	−	3E+2	1E−7	4E−10	−	−
40	Zirconium−97	D, see ^{86}Zr	6E+2	2E+3	8E−7	3E−9	9E−6	9E−5
		W, see ^{86}Zr	−	1E+3	6E−7	2E−9	−	−
		Y, see ^{86}Zr	−	1E+3	5E−7	2E−9	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
41	Niobium−88[b/]	W, all compounds except those given for Y	5E+4	2E+5	9E−5	3E−7	−	−
			St wall (7E+4)	−	−	−	1E−3	1E−2
		Y, oxides and hydroxides	−	2E+5	9E−5	3E−7	−	−
41	Niobium−89[b/] (66 min)	W, see ^{88}Nb	1E+4	4E+4	2E−5	6E−8	1E−4	1E−3
		Y, see ^{88}Nb	−	4E+4	2E−5	5E−8	−	−
41	Niobium−89 (122 min)	W, see ^{88}Nb	5E+3	2E+4	8E−6	3E−8	7E−5	7E−4
		Y, see ^{88}Nb	−	2E+4	6E−6	2E−8	−	−
41	Niobium−90	W, see ^{88}Nb	1E+3	3E+3	1E−6	4E−9	1E−5	1E−4
		Y, see ^{88}Nb	−	2E+3	1E−6	3E−9	−	−
41	Niobium−93m	W, see ^{88}Nb	9E+3	2E+3	8E−7	3E−9	−	−
			LLI wall (1E+4)	−	−	−	2E−4	2E−3
		Y, see ^{88}Nb	−	2E+2	7E−8	2E−10	−	−
41	Niobium−94	W, see ^{88}Nb	9E+2	2E+2	8E−8	3E−10	1E−5	1E−4
		Y, see ^{88}Nb	−	2E+1	6E−9	2E−11	−	−
41	Niobium−95m	W, see ^{88}Nb	2E+3	3E+3	1E−6	4E−9	−	−
			LLI wall (2E+3)	−	−	−	3E−5	3E−4
		Y, see ^{88}Nb	−	2E+3	9E−7	3E−9	−	−
41	Niobium−95	W, see ^{88}Nb	2E+3	1E+3	5E−7	2E−9	3E−5	3E−4
		Y, see ^{88}Nb	−	1E+3	5E−7	2E−9	−	−
41	Niobium−96	W, see ^{88}Nb	1E+3	3E+3	1E−6	4E−9	2E−5	2E−4
		Y, see ^{88}Nb	−	2E+3	1E−6	3E−9	−	−
41	Niobium−97[b/]	W, see ^{88}Nb	2E+4	8E+4	3E−5	1E−7	3E−4	3E−3
		Y, see ^{88}Nb	−	7E+4	3E−5	1E−7	−	−
41	Niobium−98[b/]	W, see ^{88}Nb	1E+4	5E+4	2E−5	8E−8	2E−4	2E−3
		Y, see ^{88}Nb	−	5E+4	2E−5	7E−8	−	−
42	Molybdenum−90	D, all compounds except those given for Y	4E+3	7E+3	3E−6	1E−8	3E−5	3E−4
		Y, oxides, hydroxides, and MoS_2	2E+3	5E+3	2E−6	6E−9	−	−
42	Molybdenum−93m	D, see ^{90}Mo	9E+3	2E+4	7E−6	2E−8	6E−5	6E−4
		Y, see ^{90}Mo	4E+3	1E+4	6E−6	2E−8	−	−
42	Molybdenum−93	D, see ^{90}Mo	4E+3	5E+3	2E−6	8E−9	5E−5	5E−4
		Y, see ^{90}Mo	2E+4	2E+2	8E−8	2E−10	−	−
42	Molybdenum−99	D, see ^{90}Mo	2E+3	3E+3	1E−6	4E−9	−	−
			LLI wall (1E+3)	−	−	−	2E−5	2E−4
		Y, see ^{90}Mo	1E+3	1E+3	6E−7	2E−9	−	−
42	Molybdenum−101[b/]	D, see ^{90}Mo	4E+4	1E+5	6E−5	2E−7	−	−
			St wall (5E+4)	−	−	−	7E−4	7E−3
		Y, see ^{90}Mo	−	1E+5	6E−5	2E−7	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (µCi)	ALI (µCi)	DAC (µCi/ml)	Air (µCi/ml)	Water (µCi/ml)	Concentration (µCi/ml)
43	Technetium−93m[b/]	D, all compounds except those given for W	7E+4	2E+5	6E−5	2E−7	1E−3	1E−2
		W, oxides, hydroxides, halides, and nitrates	−	3E+5	1E−4	4E−7	−	−
43	Technetium−93	D, see ^{93m}Tc	3E+4	7E+4	3E−5	1E−7	4E−4	4E−3
		W, see ^{93m}Tc	−	1E+5	4E−5	1E−7	−	−
43	Technetium−94m[b/]	D, see ^{93m}Tc	2E+4	4E+4	2E−5	6E−8	3E−4	3E−3
		W, see ^{93m}Tc	−	6E+4	2E−5	8E−8	−	−
43	Technetium−94	D, see ^{93m}Tc	9E+3	2E+4	8E−6	3E−8	1E−4	1E−3
		W, see ^{93m}Tc	−	2E+4	1E−5	3E−8	−	−
43	Technetium−95m	D, see ^{93m}Tc	4E+3	5E+3	2E−6	8E−9	5E−5	5E−4
		W, see ^{93m}Tc	−	2E+3	8E−7	3E−9	−	−
43	Technetium−95	D, see ^{93m}Tc	1E+4	2E+4	9E−6	3E−8	1E−4	1E−3
		W, see ^{93m}Tc	−	2E+4	8E−6	3E−8	−	−
43	Technetium−96m[b/]	D, see ^{93m}Tc	2E+5	3E+5	1E−4	4E−7	2E−3	2E−2
		W, see ^{93m}Tc	−	2E+5	1E−4	3E−7	−	−
43	Technetium−96	D, see ^{93m}Tc	2E+3	3E+3	1E−6	5E−9	3E−5	3E−4
		W, see ^{93m}Tc	−	2E+3	9E−7	3E−9	−	−
43	Technetium−97m	D, see ^{93m}Tc	5E+3	7E+3	3E−6	−	6E−5	6E−4
			−	St wall (7E+3)	−	1E−8	−	−
		W, see ^{93m}Tc	−	1E+3	5E−7	2E−9	−	−
43	Technetium−97	D, see ^{93m}Tc	4E+4	5E+4	2E−5	7E−8	5E−4	5E−3
		W, see ^{93m}Tc	−	6E+3	2E−6	8E−9	−	−
43	Technetium−98	D, see ^{93m}Tc	1E+3	2E+3	7E−7	2E−9	1E−5	1E−4
		W, see ^{93m}Tc	−	3E+2	1E−7	4E−10	−	−
43	Technetium−99m	D, see ^{93m}Tc	8E+4	2E+5	6E−5	2E−7	1E−3	1E−2
		W, see ^{93m}Tc	−	2E+5	1E−4	3E−7	−	−
43	Technetium−99	D, see ^{93m}Tc	4E+3	5E+3	2E−6	−	6E−5	6E−4
			−	St wall =(6E+3)	−	=(8E−9)	−	−
		W, see ^{93m}Tc	−	7E+2	3E−7	9E−10	−	−
43	Technetium−101[b/]	D, see ^{93m}Tc	9E+4	3E+5	1E−4	5E−7	−	−
			St wall (1E+5)	−	−	−	2E−3	2E−2
		W, see ^{93m}Tc	−	4E+5	2E−4	5E−7	−	−
43	Technetium−104[b/]	D, see ^{93m}Tc	2E+4	7E+4	3E−5	1E−7	−	−
			St wall (3E+4)	−	−	−	4E−4	4E−3
		W, see ^{93m}Tc	−	9E+4	4E−5	1E−7	−	−
44	Ruthenium−94[b/]	D, all compounds except those given for W and Y	2E+4	4E+4	2E−5	6E−8	2E−4	2E−3
		W, halides	−	6E+4	3E−5	9E−8	−	−
		Y, oxides and hydroxides	−	6E+4	2E−5	8E−8	−	−
44	Ruthenium−97	D, see ^{94}Ru	8E+3	2E+4	8E−6	3E−8	1E−4	1E−3
		W, see ^{94}Ru	−	1E+4	5E−6	2E−8	−	−
		Y, see ^{94}Ru	−	1E+4	5E−6	2E−8	−	−
44	Ruthenium−103	D, see ^{94}Ru	2E+3	2E+3	7E−7	2E−9	3E−5	3E−4
		W, see ^{94}Ru	−	1E+3	4E−7	1E−9	−	−
		Y, see ^{94}Ru	−	6E+2	3E−7	9E−10	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
44	Ruthenium−105	D, see ^{94}Ru	5E+3	1E+4	6E−6	2E−8	7E−5	7E−4
		W, see ^{94}Ru	−	1E+4	6E−6	2E−8	−	−
		Y, see ^{94}Ru	−	1E+4	5E−6	2E−8	−	−
44	Ruthenium−106	D, see ^{94}Ru	2E+2	9E+1	4E−8	1E−10	−	−
			LLI wall					
			(2E+2)	−	−	−	3E−6	3E−5
		W, see ^{94}Ru	−	5E+1	2E−8	8E−11	−	−
		Y, see ^{94}Ru	−	1E+1	5E−9	2E−11	−	−
45	Rhodium−99m	D, all compounds except						
		those given for W and Y	2E+4	6E+4	2E−5	8E−8	2E−4	2E−3
		W, halides	−	8E+4	3E−5	1E−7	−	−
		Y, oxides and hydroxides	−	7E+4	3E−5	9E−8	−	−
45	Rhodium−101m	D, see ^{99m}Rh	6E+3	1E+4	5E−6	2E−8	8E−5	8E−4
		W, see ^{99m}Rh	−	8E+3	4E−6	1E−8	−	−
		Y, see ^{99m}Rh	−	8E+3	3E−6	1E−8	−	−
45	Rhodium−101	D, see ^{99m}Rh	2E+3	5E+2	2E−7	7E−10	3E−5	3E−4
		W, see ^{99m}Rh	−	8E+2	3E−7	1E−9	−	−
		Y, see ^{99m}Rh	−	2E+2	6E−8	2E−10	−	−
45	Rhodium−99	D, see ^{99m}Rh	2E+3	3E+3	1E−6	4E−9	3E−5	3E−4
		W, see ^{99m}Rh	−	2E+3	9E−7	3E−9	−	−
		Y, see ^{99m}Rh	−	2E+3	8E−7	3E−9	−	−
		W, see ^{99m}Rh	−	4E+3	2E−6	6E−9	−	−
		Y, see ^{99m}Rh	−	4E+3	2E−6	5E−9	−	−
45	Rhodium−102m	D, see ^{99m}Rh	1E+3	5E+2	2E−7	7E−10	−	−
			LLI wall					
			(1E+3)	−	−	−	2E−5	2E−4
		W, see ^{99m}Rh	−	4E+2	2E−7	5E−10	−	−
		Y, see ^{99m}Rh	−	1E+2	5E−8	2E−10	−	−
45	Rhodium−102	D, see ^{99m}Rh	6E+2	9E+1	4E−8	1E−10	8E−6	8E−5
		W, see ^{99m}Rh	−	2E+2	7E−8	2E−10	−	−
		Y, see ^{99m}Rh	−	6E+1	2E−8	8E−11	−	−
45	Rhodium−103m[b/]	D, see ^{99m}Rh	4E+5	1E+6	5E−4	2E−6	6E−3	6E−2
		W, see ^{99m}Rh	−	1E+6	5E−4	2E−6	−	−
		Y, see ^{99m}Rh	−	1E+6	5E−4	2E−6	−	−
45	Rhodium−105	D, see ^{99m}Rh	4E+3	1E+4	5E−6	2E−8	−	−
			LLI wall					
			(4E+3)	−	−	−	5E−5	5E−4
		W, see ^{99m}Rh	−	6E+3	3E−6	9E−9	−	−
		Y, see ^{99m}Rh	−	6E+3	2E−6	8E−9	−	−
45	Rhodium−106m	D, see ^{99m}Rh	8E+3	3E+4	1E−5	4E−8	1E−4	1E−3
		W, see ^{99m}Rh	−	4E+4	2E−5	5E−8	−	−
		Y, see ^{99m}Rh	−	4E+4	1E−5	5E−8	−	−
45	Rhodium−107[b/]	D, see ^{99m}Rh	7E+4	2E+5	1E−4	3E−7	−	−
			St wall					
			(9E+4)	−	−	−	1E−3	1E−2
		W, see ^{99m}Rh	−	3E+5	1E−4	4E−7	−	−
		Y, see ^{99m}Rh	−	3E+5	1E−4	3E−7	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
46	Palladium−100	D, all compound44s except						
		those given for W and4 Y	1E+3	1E+3	6E−7	2E−9	2E−5	2E−4
		W, nitrates	−	1E+3	5E−7	2E−9	−	−
		Y, oxides and hydroxides	−	1E+3	6E−7	2E−9	−	−
46	Palladium−101	D, see ^{100}Pd	1E+4	3E+4	1E−5	5E−8	2E−4	2E−3
		W, see ^{100}Pd	−	3E+4	1E−5	5E−8	−	−
		Y, see ^{100}Pd	−	3E+4	1E−5	4E−8	−	−
46	Palladium−103	D, see ^{100}Pd	6E+3	6E+3	3E−6	9E−9	−	−
			LLI wall					
			(7E+3)	−	−	−	1E−4	1E−3
		W, see ^{100}Pd	−	4E+3	2E−6	6E−9	−	−
		Y, see ^{100}Pd	−	4E+3	1E−6	5E−9	−	−
46	Palladium−107	D, see ^{100}Pd	3E+4	2E+4	9E−6	−	−	−
			LLI wall	Kidneys				
			(4E+4)	(2E+4)	−	3E−8	5E−4	5E−3
		W, see ^{100}Pd	−	7E+3	3E−6	1E−8	−	−
		Y, see ^{100}Pd	−	4E+2	2E−7	6E−10	−	−
46	Palladium−109	D, see ^{100}Pd	2E+3	6E+3	3E−6	9E−9	3E−5	3E−4
		W, see ^{100}Pd	−	5E+3	2E−6	8E−9	−	−
		Y, see ^{100}Pd	−	5E+3	2E−6	6E−9	−	−
47	Silver−102[b/]	D, all compounds except						
		those given for W and Y	5E+4	2E+5	8E−5	2E−7	−	−
			St wall					
			(6E+4)	−	−	−	9E−4	9E−3
		W, nitrates and sulfides	−	2E+5	9E−5	3E−7	−	−
		Y, oxides and hydroxides	−	2E+5	8E−5	3E−7	−	−
47	Silver−103[b/]	D, see ^{102}Ag	4E+4	1E+5	4E−5	1E−7	5E−4	5E−3
		W, see ^{102}Ag	−	1E+5	5E−5	2E−7	−	−
		Y, see ^{102}Ag	−	1E+5	5E−5	2E−7	−	−
47	Silver−104m[b/]	D, see ^{102}Ag	3E+4	9E+4	4E−5	1E−7	4E−4	4E−3
		W, see ^{102}Ag	−	1E+5	5E−5	2E−7	−	−
		Y, see ^{102}Ag	−	1E+5	5E−5	2E−7	−	−
47	Silver−104[b/]	D, see ^{102}Ag	2E+4	7E+4	3E−5	1E−7	3E−4	3E−3
		W, see ^{102}Ag	−	1E+5	6E−5	2E−7	−	−
		Y, see ^{102}Ag	−	1E+5	6E−5	2E−7	−	−
47	Silver−105	D, see ^{102}Ag	3E+3	1E+3	4E−7	1E−9	4E−5	4E−4
		W, see ^{102}Ag	−	2E+3	7E−7	2E−9	−	−
		Y, see ^{102}Ag	−	2E+3	7E−7	2E−9	−	−
47	Silver−106m	D, see ^{102}Ag	8E+2	7E+2	3E−7	1E−9	1E−5	1E−4
		W, see ^{102}Ag	−	9E+2	4E−7	1E−9	−	−
		Y, see ^{102}Ag	−	9E+2	4E−7	1E−9	−	−
47	Silver−106[b/]	D, see ^{102}Ag	6E+4	2E+5	8E−5	3E−7	−	−
			St wall					
			(6E+4)	−	−	−	9E−4	9E−3
		W, see ^{102}Ag	−	2E+5	9E−5	3E−7	−	−
		Y, see ^{102}Ag	−	2E+5	8E−5	3E−7	−	−
47	Silver−108m	D, see ^{102}Ag	6E+2	2E+2	8E−8	3E−10	9E−6	9E−5
		W, see ^{102}Ag	−	3E+2	1E−7	4E−10	−	−
		Y, see ^{102}Ag	−	2E+1	1E−8	3E−11	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
47	Silver−110m	D, see ^{102}Ag	5E+2	1E+2	5E−8	2E−10	6E−6	6E−5
		W, see ^{102}Ag	−	2E+2	8E−8	3E−10	−	−
		Y, see ^{102}Ag	−	9E+1	4E−8	1E−10	−	−
47	Silver−111	D, see ^{102}Ag	9E+2	2E+3	6E−7	−	−	−
			LLI wall	Liver				
			(1E+3)	(2E+3)	−	2E−9	2E−5	2E−4
		W, see ^{102}Ag	−	9E+2	4E−7	1E−9	−	−
		Y, see ^{102}Ag	−	9E+2	4E−7	1E−9	−	−
47	Silver−112	D, see ^{102}Ag	3E+3	8E+3	3E−6	1E−8	4E−5	4E−4
		W, see ^{102}Ag	−	1E+4	4E−6	1E−8	−	−
		Y, see ^{102}Ag	−	9E+3	4E−6	1E−8	−	−
47	Silver−115[b/]	D, see ^{102}Ag	3E+4	9E+4	4E−5	1E−7	−	−
			St wall					
			(3E+4)	−	−	−	4E−4	4E−3
		W, see ^{102}Ag	−	9E+4	4E−5	1E−7	−	−
		Y, see ^{102}Ag	−	8E+4	3E−5	1E−7	−	−
48	Cadmium−104[b/]	D, all compounds except those given for W and Y	2E+4	7E+4	3E−5	9E−8	3E−4	3E−3
		W, sulfides, halides, and nitrates	−	1E+5	5E−5	2E−7	−	−
		Y, oxides and hydroxides	−	1E+5	5E−5	2E−7	−	−
48	Cadmium−107	D, see ^{104}Cd	2E+4	5E+4	2E−5	8E−8	3E−4	3E−3
		W, see ^{104}Cd	−	6E+4	2E−5	8E−8	−	−
		Y, see ^{104}Cd	−	5E+4	2E−5	7E−8	−	−
48	Cadmium−109	D, see ^{104}Cd	3E+2	4E+1	1E−8	−	−	−
			Kidneys	Kidneys				
			(4E+2)	(5E+1)	−	7E−11	6E−6	6E−5
		W, see ^{104}Cd	−	1E+2	5E−8	−	−	−
				Kidneys				
			−	(1E+2)	−	2E−10	−	−
		Y, see ^{104}Cd	−	1E+2	5E−8	2E−10	−	−
48	Cadmium−113m	D, see ^{104}Cd	2E+1	2E+0	1E−9	−	−	−
			Kidneys	Kidneys				
			(4E+1)	(4E+0)	−	5E−12	5E−7	5E−6
		W, see ^{104}Cd	−	8E+0	4E−9	−	−	−
				Kidneys				
			−	(1E+1)	−	2E−11	−	−
		Y, see ^{104}Cd	−	1E+1	5E−9	2E−11	−	−
48	Cadmium−113	D, see ^{104}Cd	2E+1	2E+0	9E−10	−	−	−
			Kidneys	Kidneys				
			(3E+1)	(3E+0)	−	5E−12	4E−7	4E−6
		W, see ^{104}Cd	−	8E+0	3E−9	−	−	−
				Kidneys				
			−	(1E+1)	−	2E−11	−	−
		Y, see ^{104}Cd	−	1E+1	6E−9	2E−11	−	−
48	Cadmium−115m	D, see ^{104}Cd	3E+2	5E+1	2E−8	−	4E−6	4E−5
				Kidneys				
			−	(8E+1)	−	1E−10	−	−
		W, see ^{104}Cd	−	1E+2	5E−8	2E−10	−	−
		Y, see ^{104}Cd	−	1E+2	6E−8	2E−10	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
48	Cadmium−115	D, see ^{104}Cd	9E+2	1E+3	6E−7	2E−9	−	−
			LLI wall (1E+3)	−	−	−	1E−5	1E−4
		W, see ^{104}Cd	−	1E+3	5E−7	2E−9	−	−
		Y, see ^{104}Cd	−	1E+3	6E−7	2E−9	−	−
48	Cadmium−117m	D, see ^{104}Cd	5E+3	1E+4	5E−6	2E−8	6E−5	6E−4
		W, see ^{104}Cd	−	2E+4	7E−6	2E−8	−	−
		Y, see ^{104}Cd	−	1E+4	6E−6	2E−8	−	−
48	Cadmium−117	D, see ^{104}Cd	5E+3	1E+4	5E−6	2E−8	6E−5	6E−4
		W, see ^{104}Cd	−	2E+4	7E−6	2E−8	−	−
		Y, see ^{104}Cd	−	1E+4	6E−6	2E−8	−	−
49	Indium−109	D, all compounds except those given for W	2E+4	4E+4	2E−5	6E−8	3E−4	3E−3
		W, oxides, hydroxides, halides, and nitrates	−	6E+4	3E−5	9E−8	−	−
49	Indium−110[b/] (69.1 min)	D, see ^{109}In	2E+4	4E+4	2E−5	6E−8	2E−4	2E−3
		W, see ^{109}In	−	6E+4	2E−5	8E−8	−	−
49	Indium−110 (4.9 h)	D, see ^{109}In	5E+3	2E+4	7E−6	2E−8	7E−5	7E−4
		W, see ^{109}In	−	2E+4	8E−6	3E−8	−	−
49	Indium−111	D, see ^{109}In	4E+3	6E+3	3E−6	9E−9	6E−5	6E−4
		W, see ^{109}In	−	6E+3	3E−6	9E−9	−	−
49	Indium−112[b/]	D, see ^{109}In	2E+5	6E+5	3E−4	9E−7	2E−3	2E−2
		W, see ^{109}In	−	7E+5	3E−4	1E−6	−	−
49	Indium−113m[b/]	D, see ^{109}In	5E+4	1E+5	6E−5	2E−7	7E−4	7E−3
		W, see ^{109}In	−	2E+5	8E−5	3E−7	−	−
49	Indium−114m	D, see ^{109}In	3E+2	6E+1	3E−8	9E−11	−	−
			LLI wall (4E+2)	−	−	−	5E−6	5E−5
		W, see ^{109}In	−	1E+2	4E−8	1E−10	−	−
49	Indium−115m	D, see ^{109}In	1E+4	4E+4	2E−5	6E−8	2E−4	2E−3
		W, see ^{109}In	−	5E+4	2E−5	7E−8	−	−
49	Indium−115	D, see ^{109}In	4E+1	1E+0	6E−10	2E−12	5E−7	5E−6
		W, see ^{109}In	−	5E+0	2E−9	8E−12	−	−
49	Indium−116m[b/]	D, see ^{109}In	2E+4	8E+4	3E−5	1E−7	3E−4	3E−3
		W, see ^{109}In	−	1E+5	5E−5	2E−7	−	−
49	Indium−117m[b/]	D, see ^{109}In	1E+4	3E+4	1E−5	5E−8	2E−4	2E−3
		W, see ^{109}In	−	4E+4	2E−5	6E−8	−	−
49	Indium−117[b/]	D, see ^{109}In	6E+4	2E+5	7E−5	2E−7	8E−4	8E−3
		W, see ^{109}In	−	2E+5	9E−5	3E−7	−	−
49	Indium−119m[b/]	D, see ^{109}In	4E+4	1E+5	5E−5	2E−7	−	−
			St wall (5E+4)	−	−	−	7E−4	7E−3
		W, see ^{109}In	−	1E+5	6E−5	2E−7	−	−
50	Tin−110	D, all compounds except those given for W	4E+3	1E+4	5E−6	2E−8	5E−5	5E−4
		W, sulfides, oxides, hydroxides, halides, nitrates, and stannic phosphate	−	1E+4	5E−6	2E−8	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
50	Tin−111[b/]	D, see ^{110}Sn	7E+4	2E+5	9E−5	3E−7	1E−3	1E−2
		W, see ^{110}Sn	−	3E+5	1E−4	4E−7	−	−
50	Tin−113	D, see ^{110}Sn	2E+3	1E+3	5E−7	2E−9	−	−
			LLI wall (2E+3)	−	−	−	3E−5	3E−4
		W, see ^{110}Sn	−	5E+2	2E−7	8E−10	−	−
50	Tin−117m	D, see ^{110}Sn	2E+3	1E+3	5E−7	−	−	−
			LLI wall (2E+3)	Bone surf (2E+3)	−	3E−9	3E−5	3E−4
		W, see ^{110}Sn	−	1E+3	6E−7	2E−9	−	−
50	Tin−119m	D, see ^{110}Sn	3E+3	2E+3	1E−6	3E−9	−	−
			LLI wall (4E+3)	−	−	−	6E−5	6E−4
		W, see ^{110}Sn	−	1E+3	4E−7	1E−9	−	−
50	Tin−121m	D, see ^{110}Sn	3E+3	9E+2	4E−7	1E−9	−	−
			LLI wall (4E+3)	−	−	−	5E−5	5E−4
		W, see ^{110}Sn	−	5E+2	2E−7	8E−10	−	−
50	Tin−121	D, see ^{110}Sn	6E+3	2E+4	6E−6	2E−8	−	−
			LLI wall (6E+3)	−	−	−	8E−5	8E−4
		W, see ^{110}Sn	−	1E+4	5E−6	2E−8	−	−
50	Tin−123m[b/]	D, see ^{110}Sn	5E+4	1E+5	5E−5	2E−7	7E−4	7E−3
		W, see ^{110}Sn	−	1E+5	6E−5	2E−7	−	−
50	Tin−123	D, see ^{110}Sn	5E+2	6E+2	3E−7	9E−10	−	−
			LLI wall (6E+2)	−	−	−	9E−6	9E−5
		W, see ^{110}Sn	−	2E+2	7E−8	2E−10	−	−
50	Tin−125	D, see ^{110}Sn	4E+2	9E+2	4E−7	1E−9	−	−
			LLI wall (5E+2)	−	−	−	6E−6	6E−5
		W, see ^{110}Sn	−	4E+2	1E−7	5E−10	−	−
50	Tin−126	D, see ^{110}Sn	3E+2	6E+1	2E−8	8E−11	4E−6	4E−5
		W, see ^{110}Sn	−	7E+1	3E−8	9E−11	−	−
50	Tin−127	D, see ^{110}Sn	7E+3	2E+4	8E−6	3E−8	9E−5	9E−4
		W, see ^{110}Sn	−	2E+4	8E−6	3E−8	−	−
50	Tin−128[b/]	D, see ^{110}Sn	9E+3	3E+4	1E−5	4E−8	1E−4	1E−3
		W, see ^{110}Sn	−	4E+4	1E−5	5E−8	−	−
51	Antimony−115[b/]	D, all compounds except those given for W	8E+4	2E+5	1E−4	3E−7	1E−3	1E−2
		W, oxides, hydroxides, halides, sulfides, sulfates, and nitrates	−	3E+5	1E−4	4E−7	−	−
51	Antimony−116m[b/]	D, see ^{115}Sb	2E+4	7E+4	3E−5	1E−7	3E−4	3E−3
		W, see ^{115}Sb	−	1E+5	6E−5	2E−7	−	−
51	Antimony−116[b/]	D, see ^{115}Sb	7E+4	3E+5	1E−4	4E−7	−	−
			St wall (9E+4)	−	−	−	1E−3	1E−2
		W, see ^{115}Sb	−	3E+5	1E−4	5E−7	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (µCi)	ALI (µCi)	DAC (µCi/ml)	Air (µCi/ml)	Water (µCi/ml)	Concentration (µCi/ml)
51	Antimony−117	D, see ^{115}Sb	7E+4	2E+5	9E−5	3E−7	9E−4	9E−3
		W, see ^{115}Sb	−	3E+5	1E−4	4E−7	−	−
51	Antimony−118m	D, see ^{115}Sb	6E+3	2E+4	8E−6	3E−8	7E−5	7E−4
		W, see ^{115}Sb	5E+3	2E+4	9E−6	3E−8	−	−
51	Antimony−119	D, see ^{115}Sb	2E+4	5E+4	2E−5	6E−8	2E−4	2E−3
		W, see ^{115}Sb	2E+4	3E+4	1E−5	4E−8	−	−
51	Antimony−120[b/] (16 min)	D, see ^{115}Sb	1E+5 St wall (2E+5)	4E+5 −	2E−4 −	6E−7 −	− 2E−3	− 2E−2
		W, see ^{115}Sb	−	5E+5	2E−4	7E−7	−	−
51	Antimony−120 (5.76 d)	D, see ^{115}Sb	1E+3	2E+3	9E−7	3E−9	1E−5	1E−4
		W, see ^{115}Sb	9E+2	1E+3	5E−7	2E−9	−	−
51	Antimony−122	D, see ^{115}Sb	8E+2 LLI wall (8E+2)	2E+3 −	1E−6 −	3E−9 −	− 1E−5	− 1E−4
		W, see ^{115}Sb	7E+2	1E+3	4E−7	2E−9	−	−
51	Antimony−124m[b/]	D, see ^{115}Sb	3E+5	8E+5	4E−4	1E−6	3E−3	3E−2
		W, see ^{115}Sb	2E+5	6E+5	2E−4	8E−7	−	−
51	Antimony−124	D, see ^{115}Sb	6E+2	9E+2	4E−7	1E−9	7E−6	7E−5
		W, see ^{115}Sb	5E+2	2E+2	1E−7	3E−10	−	−
51	Antimony−125	D, see ^{115}Sb	2E+3	2E+3	1E−6	3E−9	3E−5	3E−4
		W, see ^{115}Sb	−	5E+2	2E−7	7E−10	−	−
51	Antimony−126m[b/]	D, see ^{115}Sb	5E+4 St wall (7E+4)	2E+5 −	8E−5 −	3E−7 −	− 9E−4	− 9E−3
		W, see ^{115}Sb	−	2E+5	8E−5	3E−7	−	−
51	Antimony−126	D, see ^{115}Sb	6E+2	1E+3	5E−7	2E−9	7E−6	7E−5
		W, see ^{115}Sb	5E+2	5E+2	2E−7	7E−10	−	−
51	Antimony−127	D, see ^{115}Sb	8E+2 LLI wall (8E+2)	2E+3 −	9E−7 −	3E−9 −	− 1E−5	− 1E−4
		W, see ^{115}Sb	7E+2	9E+2	4E−7	1E−9	−	−
51	Antimony−128[b/] (10.4 min)	D, see ^{115}Sb	8E+4 St wall (1E+5)	4E+5 −	2E−4 −	5E−7 −	− 1E−3	− 1E−2
		W, see ^{115}Sb	−	4E+5	2E−4	6E−7	−	−
51	Antimony−128 (9.01 h)	D, see ^{115}Sb	1E+3	4E+3	2E−6	6E−9	2E−5	2E−4
		W, see ^{115}Sb	−	3E+3	1E−6	5E−9	−	−
51	Antimony−129	D, see ^{115}Sb	3E+3	9E+3	4E−6	1E−8	4E−5	4E−4
		W, see ^{115}Sb	−	9E+3	4E−6	1E−8	−	−
51	Antimony−130[b/]	D, see ^{115}Sb	2E+4	6E+4	3E−5	9E−8	3E−4	3E−3
		W, see ^{115}Sb	−	8E+4	3E−5	1E−7	−	−
51	Antimony−131[b/]	D, see 115Sb	1E+4 Thyroid (2E+4)	2E+4 Thyroid (4E+4)	1E−5 −	− 6E−8	− 2E−4	− 2E−3
		W, see ^{115}Sb	− −	2E+4 Thyroid (4E+4)	1E−5 −	− 6E−8	− −	− −

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
52	Tellurium−116	D, all compounds except those given for W	8E+3	2E+4	9E−6	3E−8	1E−4	1E−3
		W, oxides, hydroxides, and nitrates	−	3E+4	1E−5	4E−8	−	−
52	Tellurium−121m	D, see ^{116}Te	5E+2	2E+2	8E−8	−	−	−
			Bone surf (7E+2)	Bone surf (4E+2)	−	5E−10	1E−5	1E−4
		W, see ^{116}Te	−	4E+2	2E−7	6E−10	−	−
52	Tellurium−121	D, see ^{116}Te	3E+3	4E+3	2E−6	6E−9	4E−5	4E−4
		W, see ^{116}Te	−	3E+3	1E−6	4E−9	−	−
52	Tellurium−123m	D, see ^{116}Te	6E+2	2E+2	9E−8	−	−	−
			Bone surf (1E+3)	Bone surf (5E+2)	−	8E−10	1E−5	1E−4
		W, see ^{116}Te	−	5E+2	2E−7	8E−10	−	−
52	Tellurium−123	D, see ^{116}Te	5E+2	2E+2	8E−8	−	−	−
			Bone surf (1E+3)	Bone surf (5E+2)	−	7E−10	2E−5	2E−4
		W, see ^{116}Te	−	4E+2	2E−7	−	−	−
			Bone surf −	(1E+3)	−	2E−9	−	−
52	Tellurium−125m	D, see ^{116}Te	1E+3	4E+2	2E−7	−	−	−
			Bone surf (1E+3)	Bone surf (1E+3)	−	1E−9	2E−5	2E−4
		W, see ^{116}Te	−	7E+2	3E−7	1E−9	−	−
52	Tellurium−127m	D, see ^{116}Te	6E+2	3E+2	1E−7	−	9E−6	9E−5
			Bone surf −	(4E+2)	−	6E−10	−	−
		W, see ^{116}Te	−	3E+2	1E−7	4E−10	−	−
52	Tellurium−127	D, see ^{116}Te	7E+3	2E+4	9E−6	3E−8	1E−4	1E−3
		W, see ^{116}Te	−	2E+4	7E−6	2E−8	−	−
52	Tellurium−129m	D, see ^{116}Te	5E+2	6E+2	3E−7	9E−10	7E−6	7E−5
		W, see ^{116}Te	−	2E+2	1E−7	3E−10	−	−
52	Tellurium−129[b/]	D, see ^{116}Te	3E+4	6E+4	3E−5	9E−8	4E−4	4E−3
		W, see ^{116}Te	−	7E+4	3E−5	1E−7	−	−
52	Tellurium−131m	D, see ^{116}Te	3E+2	4E+2	2E−7	−	−	−
			Thyroid (6E+2)	Thyroid (1E+3)	−	2E−9	8E−6	8E−5
		W, see ^{116}Te	−	4E+2	2E−7	−	−	−
			−	Thyroid (9E+2)	−	1E−9	−	−
52	Tellurium−131[b/]	D, see ^{116}Te	3E+3	5E+3	2E−6	−	−	−
			Thyroid (6E+3)	Thyroid (1E+4)	−	2E−8	8E−5	8E−4
		W, see ^{116}Te	−	5E+3	2E−6	−	−	−
			−	Thyroid (1E+4)	−	2E−8	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
52	Tellurium−132	D, see ^{116}Te	2E+2 Thyroid (7E+2)	2E+2 Thyroid (8E+2)	9E−8 −	− 1E−9	− 9E−6	− 9E−5
		W, see ^{116}Te	− −	2E+2 Thyroid (6E+2)	9E−8 −	− 9E−10	− −	− −
52	Tellurium−133m[b/]	D, see ^{116}Te	3E+3 Thyroid (6E+3)	5E+3 Thyroid (1E+4)	2E−6 −	− 2E−8	− 9E−5	− 9E−4
		W, see ^{116}Te	− −	5E+3 Thyroid (1E+4)	2E−6 −	− 2E−8	− −	− −
52	Tellurium−133[b/]	D, see ^{116}Te	1E+4 Thyroid (3E+4)	2E+4 Thyroid (6E+4)	9E−6 −	− 8E−8	− 4E−4	− 4E−3
		W, see ^{116}Te	− −	2E+4 Thyroid (6E+4)	9E−6 −	− 8E−8	− −	− −
52	Tellurium−134[b/]	D, see ^{116}Te	2E+4 Thyroid (2E+4)	2E+4 Thyroid (5E+4)	1E−5 −	− 7E−8	− 3E−4	− 3E−3
		W, see ^{116}Te	− −	2E+4 Thyroid (5E+4)	1E−5 −	− 7E−8	− −	− −
53	Iodine−120m[b/]	D, all compounds	1E+4 Thyroid (1E+4)	2E+4 −	9E−6 −	3E−8 −	− 2E−4	− 2E−3
53	Iodine−120[b/]	D, all compounds	4E+3 Thyroid (8E+3)	9E+3 Thyroid (1E+4)	4E−6 −	− 2E−8	− 1E−4	− 1E−3
53	Iodine−121	D, all compounds	1E+4 Thyroid (3E+4)	2E+4 Thyroid (5E+4)	8E−6 −	− 7E−8	− 4E−4	− 4E−3
53	Iodine−123	D, all compounds	3E+3 Thyroid (1E+4)	6E+3 Thyroid (2E+4)	3E−6 −	− 2E−8	− 1E−4	− 1E−3
53	Iodine−124	D, all compounds	5E+1 Thyroid (2E+2)	8E+1 Thyroid (3E+2)	3E−8 −	− 4E−10	− 2E−6	− 2E−5
53	Iodine−125	D, all compounds	4E+1 Thyroid (1E+2)	6E+1 Thyroid (2E+2)	3E−8 −	− 3E−10	− 2E−6	− 2E−5
53	Iodine−126	D, all compounds	2E+1 Thyroid (7E+1)	4E+1 Thyroid (1E+2)	1E−8 −	− 2E−10	− 1E−6	− 1E−5
53	Iodine−128[b/]	D, all compounds	4E+4 St wall (6E+4)	1E+5 −	5E−5 −	2E−7 −	− 8E−4	− 8E−3

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of
Radionuclides for Occupational Exposure Effluent Concentrations
Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (µCi)	ALI (µCi)	DAC (µCi/ml)	Air (µCi/ml)	Water (µCi/ml)	Concentration (µCi/ml)
53	Iodine−129	D, all compounds	5E+0 Thyroid (2E+1)	9E+0 Thyroid (3E+1)	4E−9 −	− 4E−11	− 2E−7	− 2E−6
53	Iodine−130	D, all compounds	4E+2 Thyroid (1E+3)	7E+2 Thyroid (2E+3)	3E−7 −	− 3E−9	− 2E−5	− 2E−4
53	Iodine−131	D, all compounds	3E+1 Thyroid (9E+1)	5E+1 Thyroid (2E+2)	2E−8 −	− 2E−10	− 1E−6	− 1E−5
53	Iodine−132m[b/]	D, all compounds	4E+3 Thyroid (1E+4)	8E+3 Thyroid (2E+4)	4E−6 −	− 3E−8	− 1E−4	− 1E−3
53	Iodine−132	D, all compounds	4E+3 Thyroid (9E+3)	8E+3 Thyroid (1E+4)	3E−6 −	− 2E−8	− 1E−4	− 1E−3
53	Iodine−133	D, all compounds	1E+2 Thyroid (5E+2)	3E+2 Thyroid (9E+2)	1E−7 −	− 1E−9	− 7E−6	− 7E−5
53	Iodine−134[b/]	D, all compounds	2E+4 Thyroid (3E+4)	5E+4 −	2E−5 −	6E−8 −	− 4E−4	− 4E−3
53	Iodine−135	D, all compounds	8E+2 Thyroid (3E+3)	2E+3 Thyroid (4E+3)	7E−7 −	− 6E−9	− 3E−5	− 3E−4
54	Xenon−120[b/]	Submersion[a/]	−	−	1E−5	4E−8	−	−
54	Xenon−121[b/]	Submersion[a/]	−	−	2E−6	1E−8	−	−
54	Xenon−122	Submersion[a/]	−	−	7E−5	3E−7	−	−
54	Xenon−123	Submersion[a/]	−	−	6E−6	3E−8	−	−
54	Xenon−125	Submersion[a/]	−	−	2E−5	7E−8	−	−
54	Xenon−127	Submersion[a/]	−	−	1E−5	6E−8	−	−
54	Xenon−129m	Submersion[a/]	−	−	2E−4	9E−7	−	−
54	Xenon−131m	Submersion[a/]	−	−	4E−4	2E−6	−	−
54	Xenon−133m	Submersion[a/]	−	−	1E−4	6E−7	−	−
54	Xenon−133	Submersion[a/]	−	−	1E−4	5E−7	−	−
54	Xenon−135m[b/]	Submersion[a/]	−	−	9E−6	4E−8	−	−
54	Xenon−135	Submersion[a/]	−	−	1E−5	7E−8	−	−
54	Xenon−138[b/]	Submersion[a/]	−	−	4E−6	2E−8	−	−
55	Cesium−125[b/]	D, all compounds	5E+4 St wall (9E+4)	1E+5 −	6E−5	2E−7 −	− 1E−3	− 1E−2
55	Cesium−127	D, all compounds	6E+4	9E+4	4E−5	1E−7	9E−4	9E−3
55	Cesium−129	D, all compounds	2E+4	3E+4	1E−5	5E−8	3E−4	3E−3
55	Cesium−130[b/]	D, all compounds	6E+4 St wall (1E+5)	2E+5 −	8E−5 −	3E−7 −	− 1E−3	− 1E−2
55	Cesium−131	D, all compounds	2E+4	3E+4	1E−5	4E−8	3E−4	3E−3
55	Cesium−132	D, all compounds	3E+3	4E+3	2E−6	6E−9	4E−5	4E−4
55	Cesium−134m	D, all compounds	1E+5 St wall (1E+5)	1E+5 −	6E−5 −	2E−7 −	− 2E−3	− 2E−2

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
55	Cesium−134	D, all compounds	7E+1	1E+2	4E−8	2E−10	9E−7	9E−6
55	Cesium−135m[b/]	D, all compounds	1E+5	2E+5	8E−5	3E−7	1E−3	1E−2
55	Cesium−135	D, all compounds	7E+2	1E+3	5E−7	2E−9	1E−5	1E−4
55	Cesium−136	D, all compounds	4E+2	7E+2	3E−7	9E−10	6E−6	6E−5
55	Cesium−137	D, all compounds	1E+2	2E+2	6E−8	2E−10	1E−6	1E−5
55	Cesium−138[b/]	D, all compounds	2E+4	6E+4	2E−5	8E−8	–	–
			St wall (3E+4)	–	–	–	4E−4	4E−3
56	Barium−126[b/]	D, all compounds	6E+3	2E+4	6E−6	2E−8	8E−5	8E−4
56	Barium−128	D, all compounds	5E+2	2E+3	7E−7	2E−9	7E−6	7E−5
56	Barium−131m[b/]	D, all compounds	4E+5	1E+6	6E−4	2E−6	–	–
			St wall (5E+5)	–	–	–	7E−3	7E−2
56	Barium−131	D, all compounds	3E+3	8E+3	3E−6	1E−8	4E−5	4E−4
56	Barium−133m	D, all compounds	2E+3	9E+3	4E−6	1E−8	–	–
			LLI wall (3E+3)	–	–	–	4E−5	4E−4
56	Barium−135m	D, all compounds	3E+3	1E+4	5E−6	2E−8	4E−5	4E−4
56	Barium−139[b/]	D, all compounds	1E+4	3E+4	1E−5	4E−8	2E−4	2E−3
56	Barium−140	D, all compounds	5E+2	1E+3	6E−7	2E−9	–	–
			LLI wall (6E+2)	–	–	–	8E−6	8E−5
56	Barium−141[b/]	D, all compounds	2E+4	7E+4	3E−5	1E−7	3E−4	3E−3
56	Barium−142[b/]	D, all compounds	5E+4	1E+5	6E−5	2E−7	7E−4	7E−3
57	Lanthanum−131[b/]	D, all compounds except those given for W	5E+4	1E+5	5E−5	2E−7	6E−4	6E−3
		W, oxides and hydroxides	–	2E+5	7E−5	2E−7	–	–
57	Lanthanum−132	D, see ^{131}La	3E+3	1E+4	4E−6	1E−8	4E−5	4E−4
		W, see ^{131}La	–	1E+4	5E−6	2E−8	–	–
57	Lanthanum−135	D, see ^{131}La	4E+4	1E+5	4E−5	1E−7	5E−4	5E−3
		W, see ^{131}La	–	9E+4	4E−5	1E−7	–	–
57	Lanthanum−137	D, see ^{131}La	1E+4	6E+1	3E−8	–	2E−4	2E−3
			–	Liver (7E+1)	–	1E−10	–	–
		W, see ^{131}La	–	3E+2	1E−7	–	–	–
			–	Liver (3E+2)	–	4E−10	–	–
57	Lanthanum−138	D, see ^{131}La	9E+2	4E+0	1E−9	5E−12	1E−5	1E−4
		W, see ^{131}La	–	1E+1	6E−9	2E−11	–	–
57	Lanthanum−140	D, see ^{131}La	6E+2	1E+3	6E−7	2E−9	9E−6	9E−5
		W, see ^{131}La	–	1E+3	5E−7	2E−9	–	–
57	Lanthanum−141	D, see ^{131}La	4E+3	9E+3	4E−6	1E−8	5E−5	5E−4
		W, see ^{131}La	–	1E+4	5E−6	2E−8	–	–
57	Lanthanum−142[b/]	D, see ^{131}La	8E+3	2E+4	9E−6	3E−8	1E−4	1E−3
		W, see ^{131}La	–	3E+4	1E−5	5E−8	–	–
57	Lanthanum−143[b/]	D, see ^{131}La	4E+4	1E+5	4E−5	1E−7	–	–
			St wall (4E+4)	–	–	–	5E−4	5E−3
		W, see ^{131}La	–	9E+4	4E−5	1E−7	–	–

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of
Radionuclides for Occupational Exposure Effluent Concentrations
Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
58	Cerium−134	W, all compounds except those given for Y	5E+2	7E+2	3E−7	1E−9	−	−
			LLI wall (6E+2)	−	−	−	8E−6	8E−5
		Y, oxides, hydroxides, and fluorides	−	7E+2	3E−7	9E−10	−	−
58	Cerium−135	W, see ^{134}Ce	2E+3	4E+3	2E−6	5E−9	2E−5	2E−4
		Y, see ^{134}Ce	−	4E+3	1E−6	5E−9	−	−
58	Cerium−137m	W, see ^{134}Ce	2E+3	4E+3	2E−6	6E−9	−	−
			LLI wall (2E+3)	−	−	−	3E−5	3E−4
		Y, see ^{134}Ce	−	4E+3	2E−6	5E−9	−	−
58	Cerium−137	W, see ^{134}Ce	5E+4	1E+5	6E−5	2E−7	7E−4	7E−3
		Y, see ^{134}Ce	−	1E+5	5E−5	2E−7	−	−
58	Cerium−139	W, see ^{134}Ce	5E+3	8E+2	3E−7	1E−9	7E−5	7E−4
		Y, see ^{134}Ce	−	7E+2	3E−7	9E−10	−	−
58	Cerium−141	W, see ^{134}Ce	2E+3	7E+2	3E−7	1E−9	−	−
			LLI wall (2E+3)	−	−	−	3E−5	3E−4
		Y, see ^{134}Ce	−	6E+2	2E−7	8E−10	−	−
58	Cerium−143	W, see ^{134}Ce	1E+3	2E+3	8E−7	3E−9	−	−
			LLI wall (1E+3)	−	−	−	2E−5	2E−4
		Y, see ^{134}Ce	−	2E+3	7E−7	2E−9	−	−
58	Cerium−144	W, see ^{134}Ce	2E+2	3E+1	1E−8	4E−11	−	−
			LLI wall (3E+2)	−	−	−	3E−6	3E−5
		Y, see ^{134}Ce	−	1E+1	6E−9	2E−11	−	−
59	Praseodymium−136[b/]	W, all compounds except those given for Y	5E+4	2E+5	1E−4	3E−7	−	−
			St wall (7E+4)	−	−	−	1E−3	1E−2
		Y, oxides, hydroxides, carbides, and fluorides	−	2E+5	9E−5	3E−7	−	−
59	Praseodymium−137[b/]	W, see ^{136}Pr	4E+4	2E+5	6E−5	2E−7		
			5E−4	5E−3				
		Y, see ^{136}Pr	−	1E+5	6E−5	2E−7	−	−
59	Praseodymium−138m	W, see ^{136}Pr	1E+4	5E+4	2E−5	8E−8	1E−4	1E−3
		Y, see ^{136}Pr	−	4E+4	2E−5	6E−8	−	−
59	Praseodymium−139	W, see ^{136}Pr	4E+4	1E+5	5E−5	2E−7	6E−4	6E−3
		Y, see ^{136}Pr	−	1E+5	5E−5	2E−7	−	−
59	Praseodymium−142m[b/]	W, see ^{136}Pr	8E+4	2E+5	7E−5	2E−7	1E−3	1E−2
		Y, see ^{136}Pr	−	1E+5	6E−5	2E−7	−	−
59	Praseodymium−142	W, see ^{136}Pr	1E+3	2E+3	9E−7	3E−9	1E−5	1E−4
		Y, see ^{136}Pr	−	2E+3	8E−7	3E−9	−	−
59	Praseodymium−143	W, see ^{136}Pr	9E+2	8E+2	3E−7	1E−9	−	−
			LLI wall (1E+3)	−	−	−	2E−5	2E−4
		Y, see ^{136}Pr	−	7E+2	3E−7	9E−10	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
59	Praseodymium−144[b/]	W, see ^{136}Pr	3E+4	1E+5	5E−5	2E−7	−	−
			St wall (4E+4)	−	−	−	6E−4	6E−3
		Y, see ^{136}Pr	−	1E+5	5E−5	2E−7	−	−
59	Praseodymium−145	W, see ^{136}Pr	3E+3	9E+3	4E−6	1E−8	4E−5	4E−4
		Y, see ^{136}Pr	−	8E+3	3E−6	1E−8	−	−
59	Praseodymium−147[b/]	W, see ^{136}Pr	5E+4	2E+5	8E−5	3E−7	−	−
			St wall (8E+4)	−	−	−	1E−3	1E−2
		Y, see ^{136}Pr	−	2E+5	8E−5	3E−7	−	−
60	Neodymium−136[b/]	W, all compounds except those given for Y	1E+4	6E+4	2E−5	8E−8	2E−4	2E−3
		Y, oxides, hydroxides, carbides, and fluorides	−	5E+4	2E−5	8E−8	−	−
60	Neodymium−138	W, see ^{136}Nd	2E+3	6E+3	3E−6	9E−9	3E−5	3E−4
		Y, see ^{136}Nd	−	5E+3	2E−6	7E−9	−	−
60	Neodymium−139m	W, see ^{136}Nd	5E+3	2E+4	7E−6	2E−8	7E−5	7E−4
		Y, see ^{136}Nd	−	1E+4	6E−6	2E−8	−	−
60	Neodymium−139[b/]	W, see ^{136}Nd	9E+4	3E+5	1E−4	5E−7	1E−3	1E−2
		Y, see ^{136}Nd	−	3E+5	1E−4	4E−7	−	−
60	Neodymium−141	W, see ^{136}Nd	2E+5	7E+5	3E−4	1E−6	2E−3	2E−2
		Y, see ^{136}Nd	−	6E+5	3E−4	9E−7	−	−
60	Neodymium−147	W, see ^{136}Nd	1E+3	9E+2	4E−7	1E−9	−	−
			LLI wall (1E+3)	−	−	−	2E−5	2E−4
		Y, see ^{136}Nd	−	8E+2	4E−7	1E−9	−	−
60	Neodymium−149[b/]	W, see ^{136}Nd	1E+4	3E+4	1E−5	4E−8	1E−4	1E−3
		Y, see ^{136}Nd	−	2E+4	1E−5	3E−8	−	−
60	Neodymium−151[b/]	W, see ^{136}Nd	7E+4	2E+5	8E−5	3E−7	9E−4	9E−3
		Y, see ^{136}Nd	−	2E+5	8E−5	3E−7	−	−
61	Promethium−141[b/]	W, all compounds except those given for Y	5E+4	2E+5	8E−5	3E−7	−	−
			St wall (6E+4)	−	−	−	8E−4	8E−3
		Y, oxides, hydroxides, carbides, and fluorides	−	2E+5	7E−5	2E−7	−	−
61	Promethium−143	W, see ^{141}Pm	5E+3	6E+2	2E−7	8E−10	7E−5	7E−4
		Y, see ^{141}Pm	−	7E+2	3E−7	1E−9	−	−
61	Promethium−144	W, see ^{141}Pm	1E+3	1E+2	5E−8	2E−10	2E−5	2E−4
		Y, see ^{141}Pm	−	1E+2	5E−8	2E−10	−	−
61	Promethium−145	W, see ^{141}Pm	1E+4	2E+2	7E−8	−	1E−4	1E−3
			−	Bone surf (2E+2)	−	3E−10	−	−
		Y, see ^{141}Pm	−	2E+2	8E−8	3E−10	−	−
61	Promethium−146	W, see ^{141}Pm	2E+3	5E+1	2E−8	7E−11	2E−5	2E−4
		Y, see ^{141}Pm	−	4E+1	2E−8	6E−11	−	−
61	Promethium−147	W, see ^{141}Pm	4E+3	1E+2	5E−8	−	−	−
			LLI wall (5E+3)	Bone surf (2E+2)	−	3E−10	7E−5	7E−4
		Y, see ^{141}Pm	−	1E+2	6E−8	2E−10	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of
Radionuclides for Occupational Exposure Effluent Concentrations
Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
61	Promethium−148m	W, see ^{141}Pm	7E+2	3E+2	1E−7	4E−10	1E−5	1E−4
		Y, see ^{141}Pm	−	3E+2	1E−7	5E−10	−	−
61	Promethium−148	W, see ^{141}Pm	4E+2	5E+2	2E−7	8E−10	−	−
			LLI wall (5E+2)	−	−	−	7E−6	7E−5
		Y, see ^{141}Pm	−	5E+2	2E−7	7E−10	−	−
61	Promethium−149	W, see ^{141}Pm	1E+3	2E+3	8E−7	3E−9	−	−
			LLI wall (1E+3)	−	−	−	2E−5	2E−4
		Y, see ^{141}Pm	−	2E+3	8E−7	2E−9	−	−
61	Promethium−150	W, see ^{141}Pm	5E+3	2E+4	8E−6	3E−8	7E−5	7E−4
		Y, see ^{141}Pm	−	2E+4	7E−6	2E−8	−	−
61	Promethium−151	W, see ^{141}Pm	2E+3	4E+3	1E−6	5E−9	2E−5	2E−4
		Y, see ^{141}Pm	−	3E+3	1E−6	4E−9	−	−
62	Samarium−141m[b/]	W, all compounds	3E+4	1E+5	4E−5	1E−7	4E−4	4E−3
62	Samarium−141[b/]	W, all compounds	5E+4	2E+5	8E−5	2E−7	−	−
			St wall (6E+4)	−	−	−	8E−4	8E−3
62	Samarium−142[b/]	W, all compounds	8E+3	3E+4	1E−5	4E−8	1E−4	1E−3
62	Samarium−145	W, all compounds	6E+3	5E+2	2E−7	7E−10	8E−5	8E−4
62	Samarium−146	W, all compounds	1E+1	4E−2	1E−11	−	−	−
			Bone surf (3E+1)	Bone surf (6E−2)	−	9E−14	3E−7	3E−6
62	Samarium−147	W, all compounds	2E+1	4E−2	2E−11	−	−	−
			Bone surf (3E+1)	Bone surf (7E−2)	−	1E−13	4E−7	4E−6
62	Samarium−151	W, all compounds	1E+4	1E+2	4E−8	−	−	−
			LLI wall (1E+4)	Bone surf (2E+2)	−	2E−10	2E−4	2E−3
62	Samarium−153	W, all compounds	2E+3	3E+3	1E−6	4E−9	−	−
			LLI wall (2E+3)	−	−	−	3E−5	3E−4
62	Samarium−155[b/]	W, all compounds	6E+4	2E+5	9E−5	3E−7	−	−
			St wall (8E+4)	−	−	−	1E−3	1E−2
62	Samarium−156	W, all compounds	5E+3	9E+3	4E−6	1E−8	7E−5	7E−4
63	Europium−145	W, all compounds	2E+3	2E+3	8E−7	3E−9	2E−5	2E−4
63	Europium−146	W, all compounds	1E+3	1E+3	5E−7	2E−9	1E−5	1E−4
63	Europium−147	W, all compounds	3E+3	2E+3	7E−7	2E−9	4E−5	4E−4
63	Europium−148	W, all compounds	1E+3	4E+2	1E−7	5E−10	1E−5	1E−4
63	Europium−149	W, all compounds	1E+4	3E+3	1E−6	4E−9	2E−4	2E−3
63	Europium−150 (12.62 h)	W, all compounds	3E+3	8E+3	4E−6	1E−8	4E−5	4E−4
63	Europium−150 (34.2 y)	W, all compounds	8E+2	2E+1	8E−9	3E−11	1E−5	1E−4
63	Europium−152m	W, all compounds	3E+3	6E+3	3E−6	9E−9	4E−5	4E−4
63	Europium−152	W, all compounds	8E+2	2E+1	1E−8	3E−11	1E−5	1E−4
63	Europium−154	W, all compounds	5E+2	2E+1	8E−9	3E−11	7E−6	7E−5

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
63	Europium−155	W, all compounds	4E+3	9E+1	4E−8	−	5E−5	5E−4
			−	Bone surf (1E+2)	−	2E−10	−	−
63	Europium−156	W, all compounds	6E+2	5E+2	2E−7	6E−10	8E−6	8E−5
63	Europium−157	W, all compounds	2E+3	5E+3	2E−6	7E−9	3E−5	3E−4
63	Europium−158[b/]	W, all compounds	2E+4	6E+4	2E−5	8E−8	3E−4	3E−3
64	Gadolinium−145[b/]	D, all compounds except those given for W	5E+4	2E+5	6E−5	2E−7	−	−
			St wall (5E+4)	−	−	−	6E−4	6E−3
		W, oxides, hydroxides, and fluorides	−	2E+5	7E−5	2E−7	−	−
64	Gadolinium−146	D, see ^{145}Gd	1E+3	1E+2	5E−8	2E−10	2E−5	2E−4
		W, see ^{145}Gd	−	3E+2	1E−7	4E−10	−	−
64	Gadolinium−147	D, see ^{145}Gd	2E+3	4E+3	2E−6	6E−9	3E−5	3E−4
		W, see ^{145}Gd	−	4E+3	1E−6	5E−9	−	−
64	Gadolinium−148	D, see ^{145}Gd	1E+1	8E+3	3E−12	−	−	−
			Bone surf (2E+1)	Bone surf (2E−2)	−	2E−14	3E−7	3E−6
		W, see ^{145}Gd	−	3E−2	1E−11	−	−	−
			−	Bone surf (6E−2)	−	8E−14	−	−
64	Gadolinium−149	D, see ^{145}Gd	3E+3	2E+3	9E−7	3E−9	4E−5	4E−4
		W, see ^{145}Gd	−	2E+3	1E−6	3E−9	−	−
64	Gadolinium−151	D, see ^{145}Gd	6E+3	4E+2	2E−7	−	9E−5	9E−4
			−	Bone surf (6E+2)	−	9E−10	−	−
		W, see ^{145}Gd	1E+3	5E−7	2E−9	−	−	−
64	Gadolinium−152	D, see ^{145}Gd	2E+1	1E−2	4E−12	−	−	−
			Bone surf (3E+1)	Bone surf (2E−2)	−	3E−14	4E−7	4E−6
		W, see ^{145}Gd	−	4E−2	2E−11	−	−	−
			−	Bone surf (8E−2)	−	1E−13	−	−
64	Gadolinium−153	D, see ^{145}Gd	5E+3	1E+2	6E−8	−	6E−5	6E−4
			−	Bone surf (2E+2)	−	3E−10	−	−
		W, see ^{145}Gd	−	6E+2	2E−7	8E−10	−	−
64	Gadolinium−159	D, see ^{145}Gd	3E+3	8E+3	3E−6	1E−8	4E−5	4E−4
		W, see ^{145}Gd	−	6E+3	2E−6	8E−9	−	−
65	Terbium−147[b/]	W, all compounds	9E+3	3E+4	1E−5	5E−8	1E−4	1E−3
65	Terbium−149	W, all compounds	5E+3	7E+2	3E−7	1E−9	7E−5	7E−4
65	Terbium−150	W, all compounds	5E+3	2E+4	9E−6	3E−8	7E−5	7E−4
65	Terbium−151	W, all compounds	4E+3	9E+3	4E−6	1E−8	5E−5	5E−4
65	Terbium−153	W, all compounds	5E+3	7E+3	3E−6	1E−8	7E−5	7E−4
65	Terbium−154	W, all compounds	2E+3	4E+3	2E−6	6E−9	2E−5	2E−4
65	Terbium−155	W, all compounds	6E+3	8E+3	3E−6	1E−8	8E−5	8E−4
65	Terbium−156m (5.0 h)	W, all compounds	2E+4	3E+4	1E−5	4E−8	2E−4	2E−3
65	Terbium−156	W, all compounds	1E+3	1E+3	6E−7	2E−9	1E−5	1E−4

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of
Radionuclides for Occupational Exposure Effluent Concentrations
Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
65	Terbium−157	W, all compounds	5E+4	3E+2	1E−7	−	−	−
			LLI wall	Bone surf				
			(5E+4)	(6E+2)	−	8E−10	7E−4	7E−3
65	Terbium−158	W, all compounds	1E+3	2E+1	8E−9	3E−11	2E−5	2E−4
65	Terbium−160	W, all compounds	8E+2	2E+2	9E−8	3E−10	1E−5	1E−4
65	Terbium−161	W, all compounds	2E+3	2E+3	7E−7	2E−9	−	−
			LLI wall					
			(2E+3)	−	−	−	3E−5	3E−4
66	Dysprosium−155	W, all compounds	9E+3	3E+4	1E−5	4E−8	1E−4	1E−3
66	Dysprosium−157	W, all compounds	2E+4	6E+4	3E−5	9E−8	3E−4	3E−3
66	Dysprosium−159	W, all compounds	1E+4	2E+3	1E−6	3E−9	2E−4	2E−3
66	Dysprosium−165	W, all compounds	1E+4	5E+4	2E−5	6E−8	2E−4	2E−3
66	Dysprosium−166	W, all compounds	6E+2	7E+2	3E−7	1E−9	−	−
			LLI wall					
			(8E+2)	−	−	−	1E−5	1E−4
67	Holmium−155[b/]	W, all compounds	4E+4	2E+5	6E−5	2E−7	6E−4	6E−3
67	Holmium−157[b/]	W, all compounds	3E+5	1E+6	6E−4	2E−6	4E−3	4E−2
67	Holmium−159[b/]	W, all compounds	2E+5	1E+6	4E−4	1E−6	3E−3	3E−2
67	Holmium−161	W, all compounds	1E+5	4E+5	2E−4	6E−7	1E−3	1E−2
67	Holmium−162m[b/]	W, all compounds	5E+4	3E+5	1E−4	4E−7	7E−4	7E−3
67	Holmium−162[b/]	W, all compounds	5E+5	2E+6	1E−3	3E−6	−	−
			St wall					
			(8E+5)	−	−	−	1E−2	1E−1
67	Holmium−164m[b/]	W, all compounds	1E+5	3E+5	1E−4	4E−7	1E−3	1E−2
67	Holmium−164[b/]	W, all compounds	2E+5	6E+5	3E−4	9E−7	−	−
			St wall					
			(2E+5)	−	−	−	3E−3	3E−2
67	Holmium−166m	W, all compounds	6E+2	7E+0	3E−9	9E−12	9E−6	9E−5
67	Holmium−166	W, all compounds	9E+2	2E+3	7E−7	2E−9	−	−
			LLI wall					
			(9E+2)	−	−	−	1E−5	1E−4
67	Holmium−167	W, all compounds	2E+4	6E+4	2E−5	8E−8	2E−4	2E−3
68	Erbium−161	W, all compounds	2E+4	6E+4	3E−5	9E−8	2E−4	2E−3
68	Erbium−165	W, all compounds	6E+4	2E+5	8E−5	3E−7	9E−4	9E−
68	Erbium−169	W, all compounds	3E+3	3E+3	1E−6	4E−9	−	−
			LLI wall					
			(4E+3)	−	−	−	5E−5	5E−4
68	Erbium−171	W, all compounds	4E+3	1E+4	4E−6	1E−8	5E−5	5E−4
68	Erbium−172	W, all compounds	1E+3	1E+3	6E−7	2E−9	−	−
			LLI wall					
			(1E+3)	−	−	−	2E−5	2E−4
69	Thulium−162[b/]	W, all compounds	7E+4	3E+5	1E−4	4E−7	−	−
			St wall					
			(7E+4)	−	−	−	1E−3	1E−2
69	Thulium−166	W, all compounds	4E+3	1E+4	6E−6	2E−8	6E−5	6E−4
69	Thulium−167	W, all compounds	2E+3	2E+3	8E−7	3E−9	−	−
			LLI wall					
			(2E+3)	−	−	−	3E−5	3E−4

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
69	Thulium−170	W, all compounds	8E+2	2E+2	9E−8	3E−10	−	−
			LLI wall (1E+3)	−	−	−	1E−5	1E−4
69	Thulium−171	W, all compounds	1E+4	3E+2	1E−7	−	−	−
			LLI wall (1E+4)	Bone surf (6E+2)	−	8E−10	2E−4	2E−3
69	Thulium−172	W, all compounds	7E+2	1E+3	5E−7	2E−9	−	−
			LLI wall (8E+2)	−	−	−	1E−5	1E−4
69	Thulium−173	W, all compounds	4E+3	1E+4	5E−6	2E−8	6E−5	6E−4
69	Thulium−175[b/]	W, all compounds	7E+4	3E+5	2E−4	4E−7	−	−
			St wall (9E+4)	−	−	−	1E−3	1E−2
70	Ytterbium−162[b/]	W, all compounds except those given for Y	7E+4	3E+5	1E−4	4E−7	1E−3	1E−2
		Y, oxides, hydroxides, and fluorides	−	3E+5	1E−4	4E−7	−	−
70	Ytterbium−166	W, see ^{162}Yb	1E+3	2E+3	8E−7	3E−9	2E−5	2E−4
		Y, see ^{162}Yb	−	2E+3	8E−7	3E−9	−	−
70	Ytterbium−167[b/]	W, see ^{162}Yb	3E+5	8E+5	3E−4	1E−6	4E−3	4E−2
		Y, see ^{162}Yb	−	7E+5	3E−4	1E−6	−	−
70	Ytterbium−169	W, see ^{162}Yb	2E+3	8E+2	4E−7	1E−9	2E−5	2E−4
		Y, see ^{162}Yb	−	7E+2	3E−7	1E−9	−	−
70	Ytterbium−175	W, see ^{162}Yb	3E+3	4E+3	1E−6	5E−9	−	−
			LLI wall (3E+3)	−	−	−	4E−5	4E−4
		Y, see ^{162}Yb	−	3E+3	1E−6	5E−9	−	−
70	Ytterbium−177[b/]	W, see ^{162}Yb	2E+4	5E+4	2E−5	7E−8	2E−4	2E−3
		Y, see ^{162}Yb	−	5E+4	2E−5	6E−8	−	−
70	Ytterbium−178[b/]	W, see ^{162}Yb	1E+4	4E+4	2E−5	6E−8	2E−4	2E−3
		Y, see ^{162}Yb	−	4E+4	2E−5	5E−8	−	−
71	Lutetium−169	W, all compounds except those given for Y	3E+3	4E+3	2E−6	6E−9	3E−5	3E−4
		Y, oxides, hydroxides, and fluorides	−	4E+3	2E−6	6E−9	−	−
71	Lutetium−170	W, see ^{169}Lu	1E+3	2E+3	9E−7	3E−9	2E−5	2E−4
		Y, see ^{169}Lu	−	2E+3	8E−7	3E−9	−	−
71	Lutetium−171	W, see ^{169}Lu	2E+3	2E+3	8E−7	3E−9	3E−5	3E−4
		Y, see ^{169}Lu	−	2E+3	8E−7	3E−9	−	−
71	Lutetium−172	W, see ^{169}Lu	1E+3	1E+3	5E−7	2E−9	1E−5	1E−4
		Y, see ^{169}Lu	−	1E+3	5E−7	2E−9	−	−
71	Lutetium−173	W, see ^{169}Lu	5E+3	3E+2	1E−7	−	7E−5	7E−4
			−	Bone surf (5E+2)	−	6E−10	−	−
		Y, see ^{169}Lu	−	3E+2	1E−7	4E−10	−	−
71	Lutetium−174m	W, see ^{169}Lu	2E+3	2E+2	1E−7	−	−	−
			LLI wall (3E+3)	Bone surf (3E+2)	−	5E−10	4E−5	4E−4
		Y, see ^{169}Lu	−	2E+2	9E−8	3E−10	−	−

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
71	Lutetium−176	W, see ^{169}Lu	7E+2	5E+0	2E−9	−	1E−5	1E−4
			−	Bone surf (1E+1)	−	2E−11	−	−
		Y, see ^{169}Lu	−	8E+0	3E−9	1E−11	−	−
71	Lutetium−177m	W, see ^{169}Lu	7E+2	1E+2	5E−8	−	1E−5	1E−4
			−	Bone surf (1E+2)	−	2E−10	−	−
		Y, see ^{169}Lu	−	8E+1	3E−8	1E−10	−	−
71	Lutetium−177	W, see ^{169}Lu	2E+3	2E+3	9E−7	3E−9	−	−
			LLI wall (3E+3)	−	−	−	4E−5	4E−4
		Y, see ^{169}Lu	−	2E+3	9E−7	3E−9	−	−
71	Lutetium−178m[b/]	W, see ^{169}Lu	5E+4	2E+5	8E−5	3E−7	−	−
			St wall (6E+4)	−	−	−	8E−4	8E−3
		Y, see ^{169}Lu	−	2E+5	7E−5	2E−7	−	−
71	Lutetium−178[b/]	W, see ^{169}Lu	4E+4	1E+5	5E−5	2E−7	−	−
			St wall (4E+4)	−	−	−	6E−4	6E−3
		Y, see ^{169}Lu	−	1E+5	5E−5	2E−7	−	−
71	Lutetium−179	W, see ^{169}Lu	6E+3	2E+4	8E−6	3E−8	9E−5	9E−4
		Y, see ^{169}Lu	−	2E+4	6E−6	3E−8	−	−
72	Hafnium−170	D, all compounds except those given for W	3E+3	6E+3	2E−6	8E−9	4E−5	4E−4
		W, oxides, hydroxides, carbides, and nitrates	−	5E+3	2E−6	6E−9	−	−
72	Hafnium−172	D, see ^{170}Hf	1E+3	9E+0	4E−9	−	2E−5	2E−4
			−	Bone surf (2E+1)	−	3E−11	−	−
		W, see ^{170}Hf	−	4E+1	2E−8	−	−	−
			−	Bone surf (6E+1)	−	8E−11	−	−
72	Hafnium−173	D, see ^{170}Hf	5E+3	1E+4	5E−6	2E−8	7E−5	7E−4
		W, see ^{170}Hf	−	1E+4	5E−6	2E−8	−	−
72	Hafnium−175	D, see ^{170}Hf	3E+3	9E+2	4E−7	−	4E−5	4E−4
			−	Bone surf (1E+3)	−	1E−9	−	−
		W, see ^{170}Hf	−	1E+3	5E−7	2E−9	−	−
72	Hafnium−177m[b/]	D, see ^{170}Hf	2E+4	6E+4	2E−5	8E−8	3E−4	3E−3
		W, see ^{170}Hf	−	9E+4	4E−5	1E−7	−	−
72	Hafnium−178m	D, see ^{170}Hf	3E+2	1E+0	5E−10	−	3E−6	3E−5
			−	Bone surf (2E+0)	−	3E−12	−	−
		W, see ^{170}Hf	−	5E+0	2E−9	−	−	−
			−	Bone surf (9E+0)	−	1E−11	−	−
72	Hafnium−179m	D, see ^{170}Hf	1E+3	3E+2	1E−7	−	1E−5	1E−4
			−	Bone surf (6E+2)	−	8E−10	−	−
		W, see ^{170}Hf	−	6E+2	3E−7	8E−10	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
72	Hafnium−180m	D, see ^{170}Hf	7E+3	2E+4	9E−6	3E−8	1E−4	1E−3
		W, see ^{170}Hf	−	3E+4	1E−5	4E−8	−	−
72	Hafnium−181	D, see ^{170}Hf	1E+3	2E+2	7E−8	−	2E−5	2E−4
			−	Bone surf (4E+2)	−	6E−10	−	−
		W, see ^{170}Hf	−	4E+2	2E−7	6E−10	−	−
72	Hafnium−182m[b/]	D, see ^{170}Hf	4E+4	9E+4	4E−5	1E−7	5E−4	5E−3
		W, see ^{170}Hf	−	1E+5	6E−5	2E−7	−	−
72	Hafnium−182	D, see ^{170}Hf	2E+2	8E−1	3E−10	−	−	−
			Bone surf (4E+2)	Bone surf (2E+0)	−	2E−12	5E−6	5E−5
		W, see ^{170}Hf	−	3E+0	1E−9	−	−	−
			−	Bone surf (7E+0)	−	1E−11	−	−
72	Hafnium−183[b/]	D, see ^{170}Hf	2E+4	5E+4	2E−5	6E−8	3E−4	3E−3
		W, see ^{170}Hf	−	6E+4	2E−5	8E−8	−	−
72	Hafnium−184	D, see ^{170}Hf	2E+3	8E+3	3E−6	1E−8	3E−5	3E−4
		W, see ^{170}Hf	−	6E+3	3E−6	9E−9	−	−
73	Tantalum−172[b/]	W, all compounds except those given for Y	4E+4	1E+5	5E−5	2E−7	5E−4	5E−3
		Y, elemental Ta, oxides, hydroxides, halides, carbides, nitrates, and nitrides	−	1E+5	4E−5	1E−7	−	−
71	Lutetium−174	W, see ^{169}Lu	5E+3	1E+2	5E−8	−	7E−5	7E−4
			−	Bone surf (2E+2)	−	3E−10	−	−
		Y, see ^{169}Lu	−	2E+2	6E−8	2E−10	−	−
71	Lutetium−176m	W, see ^{169}Lu	8E+3	3E+4	1E−5	3E−8	1E−4	1E−3
		Y, see ^{169}Lu	−	2E+4	9E−6	3E−8	−	−
73	Tantalum−173	W, see ^{172}Ta	7E+3	2E+4	8E−6	3E−8	9E−5	9E−4
		Y, see ^{172}Ta	−	2E+4	7E−6	2E−8	−	−
73	Tantalum−174[b/]	W, see ^{172}Ta	3E+4	1E+5	4E−5	1E−7	4E−4	4E−3
		Y, see ^{172}Ta	−	9E+4	4E−5	1E−7	−	−
73	Tantalum−175	W, see ^{172}Ta	6E+3	2E+4	7E−6	2E−8	8E−5	8E−4
		Y, see ^{172}Ta	−	1E+4	6E−6	2E−8	−	−
73	Tantalum−176	W, see ^{172}Ta	4E+3	1E+4	5E−6	2E−8	5E−5	5E−4
		Y, see ^{172}Ta	−	1E+4	5E−6	2E−8	−	−
73	Tantalum−177	W, see ^{172}Ta	1E+4	2E+4	8E−6	3E−8	2E−4	2E−3
		Y, see ^{172}Ta	−	2E+4	7E−6	2E−8	−	−
73	Tantalum−178	W, see ^{172}Ta	2E+4	9E+4	4E−5	1E−7	2E−4	2E−3
		Y, see ^{172}Ta	−	7E+4	3E−5	1E−7	−	−
73	Tantalum−179	W, see ^{172}Ta	2E+4	5E+3	2E−6	8E−9	3E−4	3E−3
		Y, see ^{172}Ta	−	9E+2	4E−7	1E−9	−	−
73	Tantalum−180m	W, see ^{172}Ta	2E+4	7E+4	3E−5	9E−8	3E−4	3E−3
		Y, see ^{172}Ta	−	6E+4	2E−5	8E−8	−	−
73	Tantalum−180	W, see ^{172}Ta	1E+3	4E+2	2E−7	6E−10	2E−5	2E−4
		Y, see ^{172}Ta	−	2E+1	1E−8	3E−11	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
73	Tantalum−182m[b/]	W, see ^{172}Ta	2E+5	5E+5	2E−4	8E−7	−	−
			St wall (2E+5)	−	−	−	3E−3	3E−2
		Y, see ^{172}Ta	−	4E+5	2E−4	6E−7	−	−
73	Tantalum−182	W, see ^{172}Ta	8E+2	3E+2	1E−7	5E−10	1E−5	1E−4
		Y, see ^{172}Ta	−	1E+2	6E−8	2E−10	−	−
73	Tantalum−183	W, see ^{172}Ta	9E+2	1E+3	5E−7	2E−9	−	−
			LLI wall (1E+3)	−	−	−	2E−5	2E−4
		Y, see ^{172}Ta	−	1E+3	4E−7	1E−9	−	−
73	Tantalum−184	W, see ^{172}Ta	2E+3	5E+3	2E−6	8E−9	3E−5	3E−4
		Y, see ^{172}Ta	−	5E+3	2E−6	7E−9	−	−
73	Tantalum−185[b/]	W, see ^{172}Ta	3E+4	7E+4	3E−5	1E−7	4E−4	4E−3
		Y, see ^{172}Ta	−	6E+4	3E−5	9E−8	−	−
73	Tantalum−186[b/]	W, see ^{172}Ta	5E+4	2E+5	1E−4	3E−7	−	−
			St wall (7E+4)	−	−	−	1E−3	1E−2
		Y, see ^{172}Ta	−	2E+5	9E−5	3E−7	−	−
74	Tungsten−176	D, all compounds	1E+4	5E+4	2E−5	7E−8	1E−4	1E−3
74	Tungsten−177	D, all compounds	2E+4	9E+4	4E−5	1E−7	3E−4	3E−3
74	Tungsten−178	D, all compounds	5E+3	2E+4	8E−6	3E−8	7E−5	7E−4
74	Tungsten−179[b/]	D, all compounds	5E+5	2E+6	7E−4	2E−6	7E−3	7E−2
74	Tungsten−181	D, all compounds	2E+4	3E+4	1E−5	5E−8	2E−4	2E−3
74	Tungsten−185	D, all compounds	2E+3	7E+3	3E−6	9E−9	−	−
			LLI wall (3E+3)	−	−	−	4E−5	4E−4
74	Tungsten−187	D, all compounds	2E+3	9E+3	4E−6	1E−8	3E−5	3E−4
74	Tungsten−188	D, all compounds	4E+2	1E+3	5E−7	2E−9	−	−
			LLI wall (5E+2)	−	−	−	7E−6	7E−5
75	Rhenium−177[b/]	D, all compounds except those given for W	9E+4	3E+5	1E−4	4E−7	−	−
			St wall (1E+5)	−	−	−	2E−3	2E−2
		W, oxides, hydroxides, and nitrates	−	4E+5	1E−4	5E−7	−	−
75	Rhenium−178[b/]	D, see ^{177}Re	7E+4	3E+5	1E−4	4E−7	−	−
			St wall (1E+5)	−	−	−	1E−3	1E−2
		W, see ^{177}Re	−	3E+5	1E−4	4E−7	−	−
75	Rhenium−181	D, see ^{177}Re	5E+3	9E+3	4E−6	1E−8	7E−5	7E−4
		W, see ^{177}Re	−	9E+3	4E−6	1E−8	−	−
75	Rhenium−182 (12.7 h)	D, see ^{177}Re	7E+3	1E+4	5E−6	2E−8	9E−5	9E−4
		W, see ^{177}Re	−	2E+4	6E−6	2E−8	−	−
75	Rhenium−182 (64.0 h)	D, see ^{177}Re	1E+3	2E+3	1E−6	3E−9	2E−5	2E−4
		W, see ^{177}Re	−	2E+3	9E−7	3E−9	−	−
75	Rhenium−184m	D, see ^{177}Re	2E+3	3E+3	1E−6	4E−9	3E−5	3E−4
		W, see ^{177}Re	−	4E+2	2E−7	6E−10	−	−
75	Rhenium−184	D, see ^{177}Re	2E+3	4E+3	1E−6	5E−9	3E−5	3E−4
		W, see ^{177}Re	−	1E+3	6E−7	2E−9	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
75	Rhenium−186m	D, see ^{177}Re	1E+3	2E+3	7E−7	−	−	−
			St wall (2E+3)	St wall (2E+3)	−	3E−9	2E−5	2E−4
		W, see ^{177}Re	−	2E+2	6E−8	2E−10	−	−
75	Rhenium−186	D, see ^{177}Re	2E+3	3E+3	1E−6	4E−9	3E−5	3E−4
		W, see ^{177}Re	−	2E+3	7E−7	2E−9	−	−
75	Rhenium−187	D, see ^{177}Re	6E+5	8E+5	4E−4	−	8E−3	8E−2
			−	St wall (9E+5)	−	1E−6	−	−
		W, see ^{177}Re	−	1E+5	4E−5	1E−7	−	−
75	Rhenium−188m[b/]	D, see ^{177}Re	8E+4	1E+5	6E−5	2E−7	1E−3	1E−2
		W, see ^{177}Re	−	1E+5	6E−5	2E−7	−	−
75	Rhenium−188	D, see ^{177}Re	2E+3	3E+3	1E−6	4E−9	2E−5	2E−4
		W, see ^{177}Re	−	3E+3	1E−6	4E−9	−	−
75	Rhenium−189	D, see ^{177}Re	3E+3	5E+3	2E−6	7E−9	4E−5	4E−4
		W, see ^{177}Re	−	4E+3	2E−6	6E−9	−	−
76	Osmium−180[b/]	D, all compounds except those given for W and Y	1E+5	4E+5	2E−4	5E−7	1E−3	1E−2
		W, halides and nitrates	−	5E+5	2E−4	7E−7	−	−
		Y, oxides and hydroxides	−	5E+5	2E−4	6E−7	−	−
76	Osmium−181[b/]	D, see ^{180}Os	1E+4	4E+4	2E−5	6E−8	2E−4	2E−3
		W, see ^{180}Os	−	5E+4	2E−5	6E−8	−	−
		Y, see ^{180}Os	−	4E+4	2E−5	6E−8	−	−
76	Osmium−182	D, see ^{180}Os	2E+3	6E+3	2E−6	8E−9	3E−5	3E−4
		W, see ^{180}Os	−	4E+3	2E−6	6E−9	−	−
		Y, see ^{180}Os	−	4E+3	2E−6	6E−9	−	−
76	Osmium−185	D, see ^{180}Os	2E+3	5E+2	2E−7	7E−10	3E−5	3E−4
		W, see ^{180}Os	−	8E+2	3E−7	1E−9	−	−
		Y, see ^{180}Os	−	8E+2	3E−7	1E−9	−	−
76	Osmium−189m	D, see ^{180}Os	8E+4	2E+5	1E−4	3E−7	1E−3	1E−2
		W, see ^{180}Os	−	2E+5	9E−5	3E−7	−	−
		Y, see ^{180}Os	−	2E+5	7E−5	2E−7	−	−
76	Osmium−191m	D, see ^{180}Os	1E+4	3E+4	1E−5	4E−8	2E−4	2E−3
		W, see ^{180}Os	−	2E+4	8E−6	3E−8	−	−
		Y, see ^{180}Os	−	2E+4	7E−6	2E−8	−	−
76	Osmium−191	D, see ^{180}Os	2E+3	2E+3	9E−7	3E−9	−	−
			LLI wall (3E+3)	−	−	−	3E−5	3E−4
		W, see ^{180}Os	−	2E+3	7E−7	2E−9	−	−
		Y, see ^{180}Os	−	1E+3	6E−7	2E−9	−	−
76	Osmium−193	D, see ^{180}Os	2E+3	5E+3	2E−6	6E−9	−	−
			LLI wall (2E+3)	−	−	−	2E−5	2E−4
		W, see ^{180}Os	−	3E+3	1E−6	4E−9	−	−
		Y, see ^{180}Os	−	3E+3	1E−6	4E−9	−	−
76	Osmium−194	D, see ^{180}Os	4E+2	4E+1	2E−8	6E−11	−	−
			LLI wall (6E+2)	−	−	−	8E−6	8E−5
		W, see ^{180}Os	−	6E+1	2E−8	8E−11	−	−
		Y, see ^{180}Os	−	8E+0	3E−9	1E−11	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
77	Iridium−182[b/]	D, all compounds except those given for W and Y	4E+4	1E+5	6E−5	2E−7	−	−
			St wall (4E+4)	−	−	−	6E−4	6E−3
		W, halides, nitrates, and metallic iridium	−	2E+5	6E−5	2E−7	−	−
		Y, oxides and hydroxides	−	1E+5	5E−5	2E−7	−	−
77	Iridium−184	D, see ^{182}Ir	8E+3	2E+4	1E−5	3E−8	1E−4	1E−3
		W, see ^{182}Ir	−	3E+4	1E−5	5E−8	−	−
		Y, see ^{182}Ir	−	3E+4	1E−5	4E−8	−	−
77	Iridium−185	D, see ^{182}Ir	5E+3	1E+4	5E−6	2E−8	7E−5	7E−4
		W, see ^{182}Ir	−	1E+4	5E−6	2E−8	−	−
		Y, see ^{182}Ir	−	1E+4	4E−5	1E−8	−	−
77	Iridium−186	D, see ^{182}Ir	2E+3	8E+3	3E−6	1E−8	3E−5	3E−4
		W, see ^{182}Ir	−	6E+3	3E−6	9E−9	−	−
		Y, see ^{182}Ir	−	6E+3	2E−6	8E−9	−	−
77	Iridium−187	D, see ^{182}Ir	1E+4	3E+4	1E−5	5E−8	1E−4	1E−3
		W, see ^{182}Ir	−	3E+4	1E−5	4E−8	−	−
		Y, see ^{182}Ir	−	3E+4	1E−5	4E−8	−	−
77	Iridium−188	D, see ^{182}Ir	2E+3	5E+3	2E−6	6E−9	3E−5	3E−4
		W, see ^{182}Ir	−	4E+3	1E−6	5E−9	−	−
		Y, see ^{182}Ir	−	3E+3	1E−6	5E−9	−	−
77	Iridium−189	D, see ^{182}Ir	5E+3	5E+3	2E−6	7E−9	−	−
			LLI wall (5E+3)	−	−	−	7E−5	7E−4
		W, see ^{182}Ir	−	4E+3	2E−6	5E−9	−	−
		Y, see ^{182}Ir	−	4E+3	1E−6	5E−9	−	−
77	Iridium−190m[b/]	D, see ^{182}Ir	2E+5	2E+5	8E−5	3E−7	2E−3	2E−2
		W, see ^{182}Ir	−	2E+5	9E−5	3E−7	−	−
		Y, see ^{182}Ir	−	2E+5	8E−5	3E−7	−	−
77	Iridium−190	D, see ^{182}Ir	1E+3	9E+2	4E−7	1E−9	1E−5	1E−4
		W, see ^{182}Ir	−	1E+3	4E−7	1E−9	−	−
		Y, see ^{182}Ir	−	9E+2	4E−7	1E−9	−	−
77	Iridium−192m	D, see ^{182}Ir	3E+3	9E+1	4E−8	1E−10	4E−5	4E−4
		W, see ^{182}Ir	−	2E+2	9E−8	3E−10	−	−
		Y, see ^{182}Ir	−	2E+1	6E−9	2E−11	−	−
77	Iridium−192	D, see ^{182}Ir	9E+2	3E+2	1E−7	4E−10	1E−5	1E−4
		W, see ^{182}Ir	−	4E+2	2E−7	6E−10	−	−
		Y, see ^{182}Ir	−	2E+2	9E−8	3E−10	−	−
77	Iridium−194m	D, see ^{182}Ir	6E+2	9E+1	4E−8	1E−10	9E−6	9E−5
		W, see ^{182}Ir	−	2E+2	7E−8	2E−10	−	−
		Y, see ^{182}Ir	−	1E+2	4E−8	1E−10	−	−
77	Iridium−194	D, see ^{182}Ir	1E+3	3E+3	1E−6	4E−9	1E−5	1E−4
		W, see ^{182}Ir	−	2E+3	9E−7	3E−9	−	−
		Y, see ^{182}Ir	−	2E+3	8E−7	3E−9	−	−
77	Iridium−195m	D, see ^{182}Ir	8E+3	2E+4	1E−5	3E−8	1E−4	1E−3
		W, see ^{182}Ir	−	3E+4	1E−5	4E−8	−	−
		Y, see ^{182}Ir	−	2E+4	9E−6	3E−8	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
77	Iridium−195	D, see ^{182}Ir	1E+4	4E+4	2E−5	6E−8	2E−4	2E−3
		W, see ^{182}Ir	−	5E+4	2E−5	7E−8	−	−
		Y, see ^{182}Ir	−	4E+4	2E−5	6E−8	−	−
78	Platinum−186	D, all compounds	1E+4	4E+4	2E−5	5E−8	2E−4	2E−3
78	Platinum−188	D, all compounds	2E+3	2E+3	7E−7	2E−9	2E−5	2E−4
78	Platinum−189	D, all compounds	1E+4	3E+4	1E−5	4E−8	1E−4	1E−3
78	Platinum−191	D, all compounds	4E+3	8E+3	4E−6	1E−8	5E−5	5E−4
78	Platinum−193m	D, all compounds	3E+3	6E+3	3E−6	8E−9	−	−
			LLI wall (3E+4)	−	−	−	4E−5	4E−4
78	Platinum−193	D, all compounds	4E+4	2E+4	1E−5	3E−8	−	−
			LLI wall (5E+4)	−	−	−	6E−4	6E−3
78	Platinum−195m	D, all compounds	2E+3	4E+3	2E−6	6E−9	−	−
			LLI wall (2E+3)	−	−	−	3E−5	3E−4
78	Platinum−197m[b/]	D, all compounds	2E+4	4E+4	2E−5	6E−8	2E−4	2E−3
78	Platinum−197	D, all compounds	3E+3	1E+4	4E−6	1E−8	4E−5	4E−4
78	Platinum−199[b/]	D, all compounds	5E+4	1E+5	6E−5	2E−7	7E−4	7E−3
78	Platinum−200	D, all compounds	1E+3	3E+3	1E−6	5E−9	2E−5	2E−4
79	Gold−193	D, all compounds except those given for W and Y	9E+3	3E+4	1E−5	4E−8	1E−4	1E−3
		W, halides and nitrates	−	2E+4	9E−6	3E−8	−	−
		Y, oxides and hydroxides	−	2E+4	8E−6	3E−8	−	−
79	Gold−194	D, see ^{193}Au	3E+3	8E+3	3E−6	1E−8	4E−5	4E−4
		W, see ^{193}Au	−	5E+3	2E−6	8E−9	−	−
		Y, see ^{193}Au	−	5E+3	2E−6	7E−9	−	−
79	Gold−195	D, see ^{193}Au	5E+3	1E+4	5E−6	2E−8	7E−5	7E−4
		W, see ^{193}Au	−	1E+3	6E−7	2E−9	−	−
		Y, see ^{193}Au	−	4E+2	2E−7	6E−10	−	−
79	Gold−198m	D, see ^{193}Au	1E+3	3E+3	1E−6	4E−9	1E−5	1E−4
		W, see ^{193}Au	−	1E+3	5E−7	2E−9	−	−
		Y, see ^{193}Au	−	1E+3	5E−7	2E−9	−	−
79	Gold−198	D, see ^{193}Au	1E+3	4E+3	2E−6	5E−9	2E−5	2E−4
		W, see ^{193}Au	−	2E+3	8E−7	3E−9	−	−
		Y, see ^{193}Au	−	2E+3	7E−7	2E−9	−	−
79	Gold−199	D, see ^{193}Au	3E+3	9E+3	4E−6	1E−8	−	−
			LLI wall (3E+3)	−	−	−	4E−5	4E−4
		W, see ^{193}Au	−	4E+3	2E−6	6E−9	−	−
		Y, see ^{193}Au	−	4E+3	2E−6	5E−9	−	−
79	Gold−200m	D, see ^{193}Au	1E+3	4E+3	1E−6	5E−9	2E−5	2E−4
		W, see ^{193}Au	−	3E+3	1E−6	4E−9	−	−
		Y, see ^{193}Au	−	2E+4	1E−6	3E−9	−	−
79	Gold−200[b/]	D, see ^{193}Au	3E+4	6E+4	3E−5	9E−8	4E−4	4E−3
		W, see ^{193}Au	−	8E+4	3E−5	1E−7	−	−
		Y, see ^{193}Au	−	7E+4	3E−5	1E−7	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
79	Gold−201[b/]	D, see ^{193}Au	7E+4	2E+5	9E−5	3E−7	−	−
			St wall (9E+4)	−	−	−	1E−3	1E−2
		W, see ^{193}Au	−	2E+5	1E−4	3E−7	−	−
		Y, see ^{193}Au	−	2E+5	9E−5	3E−7	−	−
80	Mercury−193m	Vapor	−	8E+3	4E−6	1E−8	−	−
		Organic D	4E+3	1E+4	5E−6	2E−8	6E−5	6E−4
		D, sulfates	3E+3	9E+3	4E−6	1E−8	4E−5	4E−4
		W, oxides, hydroxides, halides, nitrates, and sulfides	−	8E+3	3E−6	1E−8	−	−
80	Mercury−193	Vapor	−	3E+4	1E−5	4E−8	−	−
		Organic D	2E+4	6E+4	3E−5	9E−8	3E−4	3E−3
		D, see ^{193m}Hg	2E+4	4E+4	2E−5	6E−8	2E−4	2E−3
		W, see ^{193m}Hg	−	4E+4	2E−5	6E−8	−	−
80	Mercury−194	Vapor	−	3E+1	1E−8	4E−11	−	−
		Organic D	2E+1	3E+1	1E−8	4E−11	2E−7	2E−6
		D, see ^{193m}Hg	8E+2	4E+1	2E−8	6E−11	1E−5	1E−4
		W, see ^{193m}Hg	−	1E+2	5E−8	2E−10	−	−
80	Mercury−195m	Vapor	−	4E+3	2E−6	6E−9	−	−
		Organic D	3E+3	6E+3	3E−6	8E−9	4E−5	4E−4
		D, see ^{193m}Hg	2E+3	5E+3	2E−6	7E−9	3E−5	3E−4
		W, see ^{193m}Hg	−	4E+3	2E−6	5E−9	−	−
80	Mercury−195	Vapor	−	3E+4	1E−5	4E−8	−	−
		Organic D	2E+4	5E+4	2E−5	6E−8	2E−4	2E−3
		D, see ^{193m}Hg	1E+4	4E+4	1E−5	5E−8	2E−4	2E−3
		W, see ^{193m}Hg	−	3E+4	1E−5	5E−8	−	−
80	Mercury−197m	Vapor	−	5E+3	2E−6	7E−9	−	−
		Organic D	4E+3	9E+3	4E−6	1E−8	5E−5	5E−4
		D, see ^{193m}Hg	3E+3	7E+3	3E−6	1E−8	4E−5	4E−4
		W, see ^{193m}Hg	−	5E+3	2E−6	7E−9	−	−
80	Mercury−197	Vapor	−	8E+3	4E−6	1E−8	−	−
		Organic D	7E+3	1E+4	6E−6	2E−8	9E−5	9E−4
		D, see ^{193m}Hg	6E+3	1E+4	5E−6	2E−8	8E−5	8E−4
		W, see ^{193m}Hg	−	9E+3	4E−6	1E−8	−	−
80	Mercury−199m[b/]	Vapor	−	8E+4	3E−5	1E−7	−	−
		Organic D	6E+4	2E+5	7E−5	2E−7	−	−
			St wall (1E+5)	−	−	−	1E−3	1E−2
		D, see ^{193m}Hg	6E+4	1E+5	6E−5	2E−7	8E−4	8E−3
		W, see ^{193m}Hg	−	2E+5	7E−5	2E−7	−	−
80	Mercury−203	Vapor	−	8E+2	4E−7	1E−9	−	−
		Organic D	5E+2	8E+2	3E−7	1E−9	7E−6	7E−5
		D, see ^{193m}Hg	2E+3	1E+3	5E−7	2E−9	3E−5	3E−4
		W, see ^{193m}Hg	−	1E+3	5E−7	2E−9	−	−
81	Thallium−194m[b/]	D, all compounds	5E+4	2E+5	6E−5	2E−7	−	−
			St wall (7E+4)	−	−	−	1E−3	1E−2

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
81	Thallium−194[b/]	D, all compounds	3E+5	6E+5	2E−4	8E−7	−	−
			St wall (3E+5)	−	−	−	4E−3	4E−2
81	Thallium−195[b/]	D, all compounds	6E+4	1E+5	5E−5	2E−7	9E−4	9E−3
81	Thallium−197	D, all compounds	7E+4	1E+5	5E−5	2E−7	1E−3	1E−2
81	Thallium−198m[b/]	D, all compounds	3E+4	5E+4	2E−5	8E−8	4E−4	4E−3
81	Thallium−198	D, all compounds	2E+4	3E+4	1E−5	5E−8	3E−4	3E−3
81	Thallium−199	D, all compounds	6E+4	8E+4	4E−5	1E−7	9E−4	9E−3
81	Thallium−200	D, all compounds	8E+3	1E+4	5E−6	2E−8	1E−4	1E−3
81	Thallium−201	D, all compounds	2E+4	2E+4	9E−6	3E−8	2E−4	2E−3
81	Thallium−202	D, all compounds	4E+3	5E+3	2E−6	7E−9	5E−5	5E−4
81	Thallium−204	D, all compounds	2E+3	2E+3	9E−7	3E−9	2E−5	2E−4
82	Lead−195m[b/]	D, all compounds	6E+4	2E+5	8E−5	3E−7	8E−4	8E−3
82	Lead−198	D, all compounds	3E+4	6E+4	3E−5	9E−8	4E−4	4E−3
82	Lead−199[b/]	D, all compounds	2E+4	7E+4	3E−5	1E−7	3E−4	3E−3
82	Lead−200	D, all compounds	3E+3	6E+3	3E−6	9E−9	4E−5	4E−4
82	Lead−201	D, all compounds	7E+3	2E+4	8E−6	3E−8	1E−4	1E−3
82	Lead−202m	D, all compounds	9E+3	3E+4	1E−5	4E−8	1E−4	1E−3
82	Lead−202	D, all compounds	1E+2	5E+1	2E−8	7E−11	2E−6	2E−5
82	Lead−203	D, all compounds	5E+3	9E+3	4E−6	1E−8	7E−5	7E−4
82	Lead−205	D, all compounds	4E+3	1E+3	6E−7	2E−9	5E−5	5E−4
82	Lead−209	D, all compounds	2E+4	6E+4	2E−5	8E−8	3E−4	3E−3
82	Lead−210	D, all compounds	6E−1	2E−1	1E−10	−	−	−
			Bone surf (1E+0)	Bone surf (4E−1)	−	6E−13	1E−8	1E−7
82	Lead−211[b/]	D, all compounds	1E+4	6E+2	3E−7	9E−10	2E−4	2E−3
82	Lead−212	D, all compounds	8E+1	3E+1	1E−8	5E−11	−	−
			Bone surf (1E+2)	−	−	−	2E−6	2E−5
82	Lead−214[b/]	D, all compounds	9E+3	8E+2	3E−7	1E−9	1E−4	1E−3
83	Bismuth−200[b/]	D, nitrates	3E+4	8E+4	4E−5	1E−7	4E−4	4E−3
		W, all other compounds	−	1E+5	4E−5	1E−7	−	−
83	Bismuth−201[b/]	D, see ^{200}Bi	1E+4	3E+4	1E−5	4E−8	2E−4	2E−3
		W, see ^{200}Bi	−	4E+4	2E−5	5E−8	−	−
83	Bismuth−202[b/]	D, see ^{200}Bi	1E+4	4E+4	2E−5	6E−8	2E−4	2E−3
		W, see ^{200}Bi	−	6E+4	3E−5	1E−7	−	−
83	Bismuth−203	D, see ^{200}Bi	2E+3	7E+3	3E−6	9E−9	3E−5	3E−4
		W, see ^{200}Bi	−	6E+3	3E−6	9E−9	−	−
83	Bismuth−205	D, see ^{200}Bi	1E+3	3E+3	1E−6	3E−9	2E−5	2E−4
		W, see ^{200}Bi	−	1E+3	5E−7	2E−9	−	−
83	Bismuth−206	D, see ^{200}Bi	6E+2	1E+3	6E−7	2E−9	9E−6	9E−5
		W, see ^{200}Bi	−	9E+2	4E−7	1E−9	−	−
83	Bismuth−207	D, see ^{200}Bi	1E+3	2E+3	7E−7	2E−9	1E−5	1E−4
		W, see ^{200}Bi	−	4E+2	1E−7	5E−10	−	−
83	Bismuth−210m	D, see ^{200}Bi	4E+1	5E+0	2E−9	−	−	−
			Kidneys (6E+1)	Kidneys (6E+0)	−	9E−12	8E−7	8E−6
		W, see ^{200}Bi	−	7E−1	3E−10	9E−13	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
83	Bismuth−210	D, see ^{200}Bi	8E+2	2E+2	1E−7	−	1E−5	1E−4
			−	Kidneys				
			−	(4E+2)	−	5E−10	−	−
		W, see ^{200}Bi	−	3E+1	1E−8	4E−11	−	−
83	Bismuth−212[b/]	D, see ^{200}Bi	5E+3	2E+2	1E−7	3E−10	7E−5	7E−4
		W, see ^{200}Bi	−	3E+2	1E−7	4E−10	−	−
83	Bismuth−213[b/]	D, see ^{200}Bi	7E+3	3E+2	1E−7	4E−10	1E−4	1E−3
		W, see ^{200}Bi	−	4E+2	1E−7	5E−10	−	−
83	Bismuth−214[b/]	D, see ^{200}Bi	2E+4	8E+2	3E−7	1E−9	−	−
			St wall					
			(2E+4)	−	−	−	3E−4	3E−3
		W, see ^{200}Bi	−	9E−2	4E−7	1E−9	−	−
84	Polonium−203[b/]	D, all compounds except those given for W	3E+4	6E+4	3E−5	9E−8	3E−4	3E−3
		W, oxides, hydroxides, and nitrates	−	9E+4	4E−5	1E−7	−	−
84	Polonium−205[b/]	D, see ^{203}Po	2E+4	4E+4	2E−5	5E−8	3E−4	3E−3
		W, see ^{203}Po	−	7E+4	3E−5	1E−7	−	−
84	Polonium−207	D, see ^{203}Po	8E+3	3E+4	1E−5	3E−8	1E−4	1E−3
		W, see ^{203}Po	−	3E+4	1E−5	4E−8	−	−
84	Polonium−210	D, see ^{203}Po	3E+0	6E−1	3E−10	9E−13	4E−8	4E−7
		W, see ^{203}Po	−	6E−1	3E−10	9E−13	−	−
85	Astatine−207[b/]	D, halides	6E+3	3E+3	1E−6	4E−9	8E−5	8E−4
		W	−	2E+3	9E−7	3E−9	−	−
85	Astatine−211	D, halides	1E+2	8E+1	3E−8	1E−10	2E−6	2E−5
		W	−	5E+1	2E−8	8E−11	−	−
86	Radon−220	With daughters removed	−	2E+4	7E−6	2E−8	−	−
		With daughters present	−	2E+1	9E−9	3E−11	−	−
				(or 12 WLM)	(or 1.0 WL)			
86	Radon−222	With daughters removed	−	1E+4	4E−6	1E−8	−	−
		With daughters present	−	1E+2	3E−8	1E−10	−	−
				(or 4 WLM)	(or 0.33 WL)	−	−	−
87	Francium−222[b/]	D, all compounds	2E+3	5E+2	2E−7	6E−10	3E−5	3E−4
87	Francium−223[b/]	D, all compounds	6E+2	8E+2	3E−7	1E−9	8E−6	8E−5
88	Radium−223	W, all compounds	5E+0	7E−1	3E−10	9E−13	−	−
			Bone surf					
			(9E+0)	−	−	−	1E−7	1E−6
88	Radium−224	W, all compounds	8E+0	2E+0	7E−10	2E−12	−	−
			Bone surf					
			(2E+1)	−	−	−	2E−7	2E−6
88	Radium−225	W, all compounds	8E+0	7E−1	3E−10	9E−13	−	−
			Bone surf					
			(2E+1)	−	−	−	2E−7	2E−6
88	Radium−226	W, all compounds	2E+0	6E−1	3E−10	9E−13	−	−
			Bone surf					
			(5E+0)	−	−	−	6E−8	6E−7

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
88	Radium−227[b/]	W, all compounds	2E+4	1E+4	6E−6	−	−	−
			Bone surf	Bone surf				
			(2E+4)	(2E+4)	−	3E−8	3E−4	3E−3
88	Radium−228	W, all compounds	2E+0	1E+0	5E−10	2E−12	−	−
			Bone surf					
			(4E+0)	−	−	−	6E−8	6E−7
89	Actinium−224	D, all compounds except						
		those given for W and Y	2E+3	3E+1	1E−8	−	−	−
			LLI wall	Bone surf				
			(2E+3)	(4E+1)	−	5E−11	3E−5	3E−4
		W, halides and nitrates	−	5E+1	2E−8	7E−11	−	−
		Y, oxides and hydroxides	−	5E+1	2E−8	6E−11	−	−
89	Actinium−225	D, see ^{224}Ac	5E+1	3E−1	1E−10	−	−	−
			LLI wall	Bone surf				
			(5E+1)	(5E−1)	−	7E−13	7E−7	7E−6
		W, see ^{224}Ac	−	6E−1	3E−10	9E−13	−	−
		Y, see ^{224}Ac	−	6E−1	3E−10	9E−13	−	−
89	Actinium−226	D, see ^{224}Ac	1E+2	3E+0	1E−9	−	−	−
			LLI wall	Bone surf				
			(1E+2)	(4E+0)	−	5E−12	2E−6	2E−5
		W, see ^{224}Ac	−	5E+0	2E−9	7E−12	−	−
		Y, see ^{224}Ac	−	5E+0	2E−9	6E−12	−	−
89	Actinium−227	D, see ^{224}Ac	2E−1	4E−4	2E−13	−	−	−
			Bone surf	Bone surf				
			(4E−1)	(8E−4)	−	1E−15	5E−9	5E−8
		W, see ^{224}Ac	−	2E−3	7E−13	−	−	−
			Bone surf					
			−	(3E−3)	−	4E−15	−	−
		Y, see ^{224}Ac	−	4E−3	2E−12	6E−15	−	−
89	Actinium−228	D, see ^{224}Ac	2E+3	9E+0	4E−9	−	3E−5	3E−4
			Bone surf					
			−	(2E+1)	−	2E−11	−	−
		W, see ^{224}Ac	−	4E+1	2E−8	−	−	−
			Bone surf					
			−	(6E+1)	−	8E−11	−	−
		Y, see ^{224}Ac	−	4E+1	2E−8	6E−11	−	−
90	Thorium−226[b/]	W, all compounds except						
		those given for Y	5E+3	2E+2	6E−8	2E−10	−	−
			St wall					
			(5E+3)	−	−	−	7E−5	7E−4
		Y, oxides and hydroxides	−	1E+2	6E−8	2E−10	−	−
90	Thorium−227	W, see ^{226}Th	1E+2	3E−1	1E−10	5E−13	2E−6	2E−5
		Y, see ^{226}Th	−	3E−1	1E−10	5E−13	−	−
90	Thorium−228	W, see ^{226}Th	6E+0	1E−2	4E−12	−	−	−
			Bone surf	Bone surf				
			(1E+1)	(2E−2)	−	3E−14	2E−7	2E−6
		Y, see ^{226}Th	−	2E−2	7E−12	2E−14	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
90	Thorium−229	W, see ^{226}Th	6E−1	9E−4	4E−13	−	−	−
			Bone surf (1E+0)	Bone surf (2E−3)	−	3E−15	2E−8	2E−7
		Y, see ^{226}Th	−	2E−3	1E−12	−	−	−
			−	Bone surf (3E−3)	−	4E−15	−	−
90	Thorium−230	W, see ^{226}Th	4E+0	6E−3	3E−12	−	−	−
			Bone surf (9E+0)	Bone surf (2E−2)	−	2E−14	1E−7	1E−6
		Y, see ^{226}Th	−	2E−2	6E−12	−	−	−
			−	Bone surf (2E−2)	−	3E−14	−	−
90	Thorium−231	W, see ^{226}Th	4E+3	6E+3	3E−6	9E−9	5E−5	5E−4
		Y, see ^{226}Th	−	6E+3	3E−6	9E−9	−	−
90	Thorium−232	W, see ^{226}Th	7E−1	1E−3	5E−13	−	−	−
			Bone surf (2E+0)	Bone surf (3E−3)	−	4E−15	3E−8	3E−7
		Y, see ^{226}Th	−	3E−3	1E−12	−	−	−
			−	Bone surf (4E−3)	−	6E−15	−	−
90	Thorium−234	W, see ^{226}Th	3E+2	2E+2	8E−8	3E−10	−	−
			LLI wall (4E+2)	−	−	−	5E−6	5E−5
		Y, see ^{226}Th	−	2E+2	6E−8	2E−10	−	−
91	Protactinium−227[b/]	W, all compounds except those given for Y	4E+3	1E+2	5E−8	2E−10	5E−5	5E−4
		Y, oxides and hydroxides	−	1E+2	4E−8	1E−10	−	−
91	Protactinium−228	W, see ^{227}Pa	1E+3	1E+1	5E−9	−	2E−5	2E−4
			−	Bone surf (2E+1)	−	3E−11	−	−
		Y, see ^{227}Pa	−	1E+1	5E−9	2E−11	−	−
91	Protactinium−230	W, see ^{227}Pa	6E+2	5E+0	2E−9	7E−12	−	−
			(9E+2)	Bone surf −	−	−	1E−5	1E−4
		Y, see ^{227}Pa	−	4E+0	1E−9	5E−12	−	−
91	Protactinium−231	W, see ^{227}Pa	2E−1	2E−3	6E−13	−	−	−
			(5E−1)	Bone surf (4E−3)	Bone surf −	6E−15	6E−9	6E−8
		Y, see ^{227}Pa	−	4E−3	2E−12	−	−	−
			−	Bone surf (6E−3)	−	8E−15	−	−
91	Protactinium−232	W, see ^{227}Pa	1E+3	2E+1	9E−9	−	2E−5	2E−4
			−	Bone surf (6E+1)	−	8E−11	−	−
		Y, see ^{227}Pa	−	6E+1	2E−8	−	−	−
			−	Bone surf (7E+1)	−	1E−10	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
91	Protactinium−233	W, see ^{227}Pa	1E+3	7E+2	3E−7	1E−9	−	−
			LLI wall (2E+3)	−	−	−	2E−5	2E−4
		Y, see ^{227}Pa	−	6E+2	2E−7	8E−10	−	−
91	Protactinium−234	W, see ^{227}Pa	2E+3	8E+3	3E−6	1E−8	3E−5	3E−4
		Y, see ^{227}Pa	−	7E+3	3E−6	9E−9	−	−
92	Uranium−230	D, UF_6, UO_2F_2, UO_2,$(NO_3)_2$	4E+0 Bone surf (6E+0)	4E−1 Bone surf (6E−1)	2E−10 −	− 8E−13	− 8E−8	− 8E−7
		W, UO_3, UF_4, UCl_4	−	4E−1	1E−10	5E−13	−	−
		Y, UO_2, U_3O_8	−	3E−1	1E−10	4E−13	−	−
92	Uranium−231	D, see ^{230}U	5E+3	8E+3	3E−6	1E−8	−	−
			LLI wall (4E+3)	−	−	−	6E−5	6E−4
		W, see ^{230}U	−	6E+3	2E−6	8E−9	−	−
		Y, see ^{230}U	−	5E+3	2E−6	6E−9	−	−
92	Uranium−232	D, see ^{230}U	2E+0 Bone surf (4E+0)	2E−1 Bone surf (4E−1)	9E−11 −	− 6E−13	− 6E−8	− 6E−7
		W, see ^{230}U	−	4E−1	2E−10	5E−13	−	−
		Y, see ^{230}U	−	8E−3	3E−12	1E−14	−	−
92	Uranium−233	D, see ^{230}U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	5E−10 −	− 3E−12	− 3E−7	− 3E−6
		W, see ^{230}U	−	7E−1	3E−10	1E−12	−	−
		Y, see ^{230}U	−	4E−2	2E−11	5E−14	−	−
92	Uranium−234[c/]	D, see ^{230}U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	5E−10 −	− 3E−12	− 3E−7	− 3E−6
		W, see ^{230}U	−	7E−1	3E−10	1E−12	−	−
		Y, see ^{230}U	−	4E−2	2E−11	5E−14	−	−
92	Uranium−235[c/]	D, see ^{230}U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	6E−10 −	− 3E−12	− 3E−7	− 3E−6
		W, see ^{230}U	−	8E−1	3E−10	1E−12	−	−
		Y, see ^{230}U	−	4E−2	2E−11	6E−14	−	−
92	Uranium−236	D, see ^{230}U	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	5E−10 −	− 3E−12	− 3E−7	− 3E−6
		W, see ^{230}U	−	8E−1	3E−10	1E−12	−	−
		Y, see ^{230}U	−	4E−2	2E−11	6E−14	−	−
92	Uranium−237	D, see ^{230}U	2E+3	3E+3	1E−6	4E−9	−	−
			LLI wall (2E+3)	−	−	−	3E−5	3E−4
		W, see ^{230}U	−	2E+3	7E−7	2E−9	−	−
		Y, see ^{230}U	−	2E+3	6E−7	2E−9	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
92	Uranium−238[c/]	D, see ^{230}U	1E+1	1E+0	6E−10	−	−	−
			Bone surf (2E+1)	Bone surf (2E+0)	−	3E−12	3E−7	3E−6
		W, see ^{230}U	−	8E−1	3E−10	1E−12	−	−
		Y, see ^{230}U	−	4E−2	2E−11	6E−14	−	−
92	Uranium−239[b/]	D, see ^{230}U	7E+4	2E+5	8E−5	3E−7	9E−4	9E−3
		W, see ^{230}U	−	2E+5	7E−5	2E−7	−	−
		Y, see ^{230}U	−	2E+5	6E−5	2E−7	−	−
92	Uranium−240	D, see ^{230}U	1E+3	4E+3	2E−6	5E−9	2E−5	2E−4
		W, see ^{230}U	−	3E+3	1E−6	4E−9	−	−
		Y, see ^{230}U	−	2E+3	1E−5	3E−9	−	−
92	Uranium−natural[c/]	D, see ^{230}U	1E+1	1E+0	5E−10	−	−	−
			Bone surf (2E+1)	Bone surf (2E+0)	−	3E−12	3E−7	3E−6
		W, see ^{230}U	−	8E−1	3E−10	9E−13	−	−
		Y, see ^{230}U	−	5E−2	2E−11	9E−14	−	−
93	Neptunium−232[b/]	W, all compounds	1E+5	2E+3	7E−7	−	2E−3	2E−2
			Bone surf −	(5E+2)	−	6E−9	−	−
93	Neptunium−233[b/]	W, all compounds	8E+5	3E+6	1E−3	4E−6	1E−2	1E−1
93	Neptunium−234	W, all compounds	2E+3	3E+3	1E−6	4E−9	3E−5	3E−4
93	Neptunium−235	W, all compounds	2E+4	8E+2	3E−7	−	−	−
			LLI wall (2E+4)	Bone surf (1E+3)	−	2E−9	3E−4	3E−3
93	Neptunium−236 (1.15E+5 y)	W, all compounds	3E+0	2E−2	9E−12	−	−	−
			Bone surf (6E+0)	Bone surf (5E−2)	−	8E−14	9E−8	9E−7
93	Neptunium−236 (22.5 h)	W, all compounds	3E+3	3E+1	1E−8	−	−	−
			Bone surf (4E+3)	Bone surf (7E+1)	−	1E−10	5E−5	5E−4
93	Neptunium−237	W, all compounds	5E−1	4E−3	2E−12	−	−	−
			Bone surf (1E+0)	Bone surf (1E−2)	−	1E−14	2E−8	2E−7
93	Neptunium−238	W, all compounds	1E+3	6E+1	3E−8	−	2E−5	2E−4
			Bone surf −	(2E+2)	−	2E−10	−	−
93	Neptunium−239	W, all compounds	2E+3	2E+3	9E−7	3E−9	−	−
			LLI wall (2E+3)	−	−	−	2E−5	2E−4
93	Neptunium−240[b/]	W, all compounds	2E+4	8E+4	3E−5	1E−7	3E−4	3E−3
94	Plutonium−234	W, all compounds except PuO_2	8E+3	2E+2	9E−8	3E−10	1E−4	1E−3
		Y, PuO_2	−	2E+2	8E−8	3E−10	−	−
94	Plutonium−235[b/]	W, see ^{234}Pu	9E+5	3E+6	1E−3	4E−6	1E−2	1E−1
		Y, see ^{234}Pu	−	3E+6	1E−3	3E−6	−	−
94	Plutonium−236	W, see ^{234}Pu	2E+0	2E−2	8E−12	−	−	−
			Bone surf (4E+0)	Bone surf (4E−2)	−	5E−14	6E−8	6E−7
		Y, see ^{234}Pu	−	4E−2	2E−11	6E−14	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
94	Plutonium−237	W, see ^{234}Pu	1E+4	3E+3	1E−6	5E−9	2E−4	2E−3
		Y, see ^{234}Pu	−	3E+3	1E−6	4E−9	−	−
94	Plutonium−238	W, see ^{234}Pu	9E−1	7E−3	3E−12	−	−	−
			Bone surf (2E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7
		Y, see ^{234}Pu	−	2E−2	8E−12	2E−14	−	−
94	Plutonium−239	W, see ^{234}Pu	8E−1	6E−3	3E−12	−	−	−
			Bone surf (1E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7
		Y, see ^{234}Pu	−	2E−2	7E−12	−	−	−
			−	Bone surf (2E−2)	−	2E−14	−	−
94	Plutonium−240	W, see ^{234}Pu	8E−1	6E−3	3E−12	−	−	−
			Bone surf (1E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7
		Y, see ^{234}Pu	−	2E−2	7E−12	−	−	−
			−	Bone surf (2E−2)	−	2E−14	−	−
94	Plutonium−241	W, see ^{234}Pu	4E+1	3E−1	1E−10	−	−	−
			Bone surf (7E+1)	Bone surf (6E−1)	−	8E−13	1E−6	1E−5
		Y, see ^{234}Pu	−	8E−1	3E−10	−	−	−
			−	Bone surf (1E+0)	−	1E−12	−	−
94	Plutonium−242	W, see ^{234}Pu	8E−1	7E−3	3E−12	−	−	−
			Bone surf (1E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7
		Y, see ^{234}Pu	−	2E−2	7E−12	−	−	−
			−	Bone surf (2E−2)	−	2E−14	−	−
94	Plutonium−243	W, see ^{234}Pu	2E+4	4E+4	2E−5	5E−8	2E−4	2E−3
		Y, see ^{234}Pu	−	4E+4	2E−5	5E−8	−	−
94	Plutonium−244	W, see ^{234}Pu	8E−1	7E−3	3E−12	−	−	−
			Bone surf (2E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7
		Y, see ^{234}Pu	−	2E−2	7E−12	−	−	−
			−	Bone surf (2E−2)	−	2E−14	−	−
94	Plutonium−245	W, see ^{234}Pu	2E+3	5E+3	2E−6	6E−9	3E−5	3E−4
		Y, see ^{234}Pu	−	4E+3	2E−6	6E−9	−	−
94	Plutonium−246	W, see ^{234}Pu	4E+2	3E+2	1E−7	4E−10	−	−
			LLI wall (4E+2)	−	−	−	6E−6	6E−5
		Y, see ^{234}Pu	−	3E+2	1E−7	4E−10	−	−
95	Americium−237[b/]	W, all compounds	8E+4	3E+5	1E−4	4E−7	1E−3	1E−2
95	Americium−238b/	W, all compounds	4E+4	3E+3	1E−6	−	5E−4	5E−3
			−	Bone surf (6E+3)	−	9E−9	−	−
95	Americium−239	W, all compounds	5E+3	1E+4	5E−6	2E−8	7E−5	7E−4
95	Americium−240	W, all compounds	2E+3	3E+3	1E−6	4E−9	3E−5	3E−4

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
95	Americium−241	W, all compounds	8E−1	6E−3	3E−12	−	−	−
			Bone surf (1E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7
95	Americium−242m	W, all compounds	8E−1	6E−3	3E−12	−	−	−
			Bone surf (1E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7
95	Americium−242	W, all compounds	4E+3	8E+1	4E−8	−	5E−5	5E−4
			−	Bone surf (9E+1)	−	1E−10	−	−
95	Americium−243	W, all compounds	8E−1	6E−3	3E−12	−	−	−
			Bone surf (1E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7
95	Americium−244m[b/]	W, all compounds	6E+4	4E+3	2E−6			
			St wall (8E+4)	Bone surf (7E+3)	−	1E−8	1E−3	1E−2
95	Americium−244	W, all compounds	3E+3	2E+2	8E−8	−	4E−5	4E−4
			−	Bone surf (3E+2)	−	4E−10	−	−
95	Americium−245	W, all compounds	3E+4	8E+4	3E−5	1E−7	4E−4	4E−3
95	Americium−246m[b/]	W, all compounds	5E+4	2E+5	8E−5	3E−7	−	−
			St wall (6E+4)	−	−	−	8E−4	8E−3
95	Americium−246[b/]	W, all compounds	3E+4	1E+5	4E−5	1E−7	4E−4	4E−3
96	Curium−238	W, all compounds	2E+4	1E+3	5E−7	2E−9	2E−4	2E−3
96	Curium−240	W, all compounds	6E+1	6E−1	2E−10	−	−	−
			Bone surf (8E+1)	Bone surf (6E−1)	−	9E−13	1E−6	1E−5
96	Curium−241	W, all compounds	1E+3	3E+1	1E−8	−	2E−5	2E−4
			−	Bone surf (4E+1)	−	5E−11	−	−
96	Curium−242	W, all compounds	3E+1	3E−1	1E−10	−	−	−
			Bone surf (5E+1)	Bone surf (3E−1)	−	4E−13	7E−7	7E−6
96	Curium−243	W, all compounds	1E+0	9E−3	4E−12	−	−	−
			Bone surf (2E+0)	Bone surf (2E−2)	−	2E−14	2E−8	3E−7
96	Curium−244	W, all compounds	1E+0	1E−2	5E−12	−	−	−
			Bone surf (3E+0)	Bone surf (2E−2)	−	3E−14	3E−8	3E−7
96	Curium−245	W, all compounds	7E−1	6E−3	3E−12	−	−	−
			Bone surf (1E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7
96	Curium−246	W, all compounds	7E−1	6E−3	3E−12	−	−	−
			Bone surf (1E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7
96	Curium−247	W, all compounds	8E−1	6E−3	3E−12	−	−	−
			Bone surf (1E+0)	Bone surf (1E−2)	−	2E−14	2E−8	2E−7

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
96	Curium−248	W, all compounds	2E−1	2E−3	7E−13	−	−	−
			Bone surf (4E−1)	Bone surf (3E−3)	−	4E−15	5E−9	5E−8
96	Curium−249[b/]	W, all compounds	5E+4	2E+4	7E−6	−	7E−4	7E−3
			−	Bone surf (3E+4)	−	4E−8	−	−
96	Curium−250	W, all compounds	4E−2	3E−4	1E−13	−	−	−
			Bone surf (6E−2)	Bone surf (5E−4)	−	8E−16	9E−10	9E−9
97	Berkelium−245	W, all compounds	2E+3	1E+3	5E−7	2E−9	3E−5	3E−4
97	Berkelium−246	W, all compounds	3E+3	3E+3	1E−6	4E−9	4E−5	4E−4
97	Berkelium−247	W, all compounds	5E−1	4E−3	2E−12	−	−	−
			Bone surf (1E+0)	Bone surf (9E−3)	−	1E−14	2E−8	2E−7
97	Berkelium−249	W, all compounds	2E+2	2E+0	7E−10	−	−	−
			Bone surf (5E+2)	Bone surf (4E+0)	−	5E−12	6E−6	6E−5
97	Berkelium−250	W, all compounds	9E+3	3E+2	1E−7	−	1E−4	1E−3
			−	Bone surf (7E+2)	−	1E−9	−	−
98	Californium−244[b/]	W, all compounds except those given for Y	3E+4	6E+2	2E−7	8E−10	−	−
			St wall (3E+4)	−	−	−	4E−4	4E−3
		Y, oxides and hydroxides	−	6E+2	2E−7	8E−10	−	−
98	Californium−246	W, see ^{244}Cf	4E+2	9E+0	4E−9	1E−11	5E−6	5E−5
		Y, see ^{244}Cf	−	9E+0	4E−9	1E−11	−	−
98	Californium−248	W, see ^{244}Cf	8E+0	6E−2	3E−11	−	−	−
			Bone surf (2E+1)	Bone surf (1E−1)	−	2E−13	2E−7	2E−6
		Y, see ^{244}Cf	−	1E−1	4E−11	1E−13	−	−
98	Californium−249	W, see ^{244}Cf	5E−1	4E−3	2E−12	−	−	−
			Bone surf (1E+0)	Bone surf (9E−3)	−	1E−14	2E−8	2E−7
		Y, see ^{244}Cf	−	1E−2	4E−12	−	−	−
			−	Bone surf (1E−2)	−	2E−14	−	−
98	Californium−250	W, see ^{244}Cf	1E+0	9E−3	4E−12	−	−	−
			Bone surf (2E+0)	Bone surf (2E−2)	−	3E−14	3E−8	3E−7
		Y, see ^{244}Cf	−	3E−2	1E−11	4E−14	−	−
98	Californium−251	W, see ^{244}Cf	5E−1	4E−3	2E−12	−	−	−
			Bone surf (1E+0)	Bone surf (9E−3)	−	1E−14	2E−8	2E−7
		Y, see ^{244}Cf	−	1E−2	4E−12	−	−	−
			−	Bone surf (1E−2)	−	2E−14	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure Effluent Concentrations Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
98	Californium−252	W, see ^{244}Cf	2E+0	2E−2	8E−12	−	−	−
			Bone surf (5E+0)	Bone surf (4E−2)	−	5E−14	7E−8	7E−7
		Y, see ^{244}Cf	−	3E−2	1E−11	5E−14	−	−
98	Californium−253	W, see ^{244}Cf	2E+2	2E+0	8E−10	3E−12	−	−
			Bone surf (4E+2)	−	−	−	5E−6	5E−5
		Y, see ^{244}Cf	−	2E+0	7E−10	2E−12	−	−
98	Californium−254	W, see ^{244}Cf	2E+0	2E−2	9E−12	3E−14	3E−8	3E−7
		Y, see ^{244}Cf	−	2E−2	7E−12	2E−14	−	−
99	Einsteinium−250	W, all compounds	4E+4	5E+2	2E−7	−	6E−4	6E−3
			−	Bone surf (1E+3)	−	2E−9	−	−
99	Einsteinium−251	W, all compounds	7E+3	9E+2	4E−7	−	1E−4	1E−3
			−	Bone surf (1E+3)	−	2E−9	−	−
99	Einsteinium−253	W, all compounds	2E+2	1E+0	6E−10	2E−12	2E−6	2E−5
99	Einsteinium−254m	W, all compounds	3E+2	1E+1	4E−9	1E−11	−	−
			LLI wall (3E+2)	−	−	−	4E−6	4E−5
99	Einsteinium−254	W, all compounds	8E+0	7E−2	3E−11	−	−	−
			Bone surf (2E+1)	Bone surf (1E−1)	−	2E−13	2E−7	2E−6
100	Fermium−252	W, all compounds	5E+2	1E+1	5E−9	2E−11	6E−6	6E−5
100	Fermium−253	W, all compounds	1E+3	1E+1	4E−9	1E−11	1E−5	1E−4
100	Fermium−254	W, all compounds	3E+3	9E+1	4E−8	1E−10	4E−5	4E−4
100	Fermium−255	W, all compounds	5E+2	2E+1	9E−9	3E−11	7E−6	7E−5
100	Fermium−257	W, all compounds	2E+1	2E−1	7E−11	−	−	−
			Bone surf (4E+1)	Bone surf (2E−1)	−	3E−13	5E−7	5E−6
101	Mendelevium−257	W, all compounds	7E+3	8E+1	4E−8	−	1E−4	1E−3
			−	Bone surf (9E+1)	−	1E−10	−	−
101	Mendelevium−258	W, all compounds	3E+1	2E−1	1E−10	−	−	−
			Bone surf (5E+1)	Bone surf (3E−1)	−	5E−13	6E−7	6E−6
−Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half− life less than 2 hours		Submersion[a/]	−	2E+2	1E−7	1E−9	−	−
−Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half− life greater than 2 hours		....	−	2E−1	1E−10	1E−12	1E−8	1E−7

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of
Radionuclides for Occupational Exposure Effluent Concentrations
Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
−Any single radionuclide not listed above that decays by alpha emission or spontaneous fission, or any mixture for which either the identity or the concentration of any radionuclide in the mixture is not known		....	−	4E−4	2E−13	1E−15	2E−9	2E−8

Footnotes:

a/ "Submersion" means that values given are for submersion in a hemispherical semi−infinite cloud of airborne material.

b/ These radionuclides have radiological half−lives of less than 2 hours. The total effective dose equivalent received during operations with these radionuclides might include a significant contribution from external exposure. The DAC values for all radionuclides, other than those designated Class "Submersion," are based upon the committed effective dose equivalent due to the intake of the radionuclide into the body and do NOT include potentially significant contributions to dose equivalent from external exposures. The licensee may substitute 1E−7 μCi/ml for the listed DAC to account for the submersion dose prospectively, but should use individual monitoring devices or other radiation measuring instruments that measure external exposure to demonstrate compliance with the limits. (See s. DHS 157.22 (3))

c/ For soluble mixtures of U−238, U−234, and U−235 in air, chemical toxicity may be the limiting factor (see D.201e.). If the percent by weight enrichment of U−235 is not greater than 5, the concentration value for a 40−hour workweek is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40−hour workweek may not exceed 8E−3 (SA) μCi−hr/ml, where SA is the specific activity of the uranium inhaled. The specific activity for natural uranium is 6.77E−7 curies per gram U. The specific activity for other mixtures of U−238, U−235, and U−234, if not known, shall be:

SA = 3.6E−7 curies/gram U U−depleted
SA = [0.4 + 0.38 enrichment + 0.0034 enrichment^2] E−6, enrichment > 0.72
where enrichment is the percentage by weight of U−235, expressed as percent.

Note:

1. If the identity of each radionuclide in a mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture shall be the most restrictive DAC of any radionuclide in the mixture.

2. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in this appendix are not present in the mixture, the inhalation ALI, DAC, and effluent and sewage concentrations for the mixture are the lowest values specified in this appendix for any radionuclide that is not known to be absent from the mixture; or

If it is known that Ac−227−D and Cm−250−W are not present	−	7E−4	3E−13	−	−	−
If, in addition, it is known that Ac−227−W,Y, Th−229−W,Y, Th−230−W, Th−232−W,Y, Pa−231−W,Y, Np−237−W, Pu−239−W, Pu−240−W, Pu−242−W, Am−241−W, Am−242m−W, Am−243−W, Cm−245−W, Cm−246−W, Cm−247−W, Cm−248−W, Bk−247−W, Cf−249−W, and Cf−251−W are not present	−	7E−3	3E−12	−	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of
Radionuclides for Occupational Exposure Effluent Concentrations
Concentrations for Release to Sanitary Sewerage (Continued)

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		If, in addition, it is known that Sm−146−W, Sm−147−W, Gd−148−D,W, Gd−152−D,W, Th−228−W,Y, Th−230−Y, U−232−Y, U−233−Y, U−234−Y, U−235−Y, U−236−Y, U−238−Y, Np−236−W, Pu−236−W,Y, Pu−238−W,Y, Pu−239−Y, Pu−240−Y, Pu−242−Y, Pu−244−W,Y, Cm−243−W, Cm−244−W, Cf−248−W, Cf−249−Y, Cf−250−W,Y, Cf−251−Y, Cf−252−W,Y, and Cf−254−W,Y are not present....	7E−2	3E−11	−	−	−	
		If, in addition, it is known that Pb−210−D, Bi−210m−W, Po−210−D,W, Ra−223−W, Ra−225−W, Ra−226−W, Ac−225−D,W,Y, Th−227−W,Y, U−230−D,W,Y, U−232−D,W, Pu−241−W, Cm−240−W, Cm−242−W, Cf−248−Y, Es−254−W, Fm−257−W, and Md−258−W are not present	−	7E−1	3E−10	−	−	−
		If, in addition, it is known that Si−32−Y, Ti−44−Y, Fe−60−D, Sr−90−Y, Zr−93−D, Cd−113m−D, Cd−113−D, In−115−D,W, La−138−D, Lu−176−W, Hf−178m−D,W, Hf−182−D,W, Bi−210m−D, Ra−224−W, Ra−228−W, Ac−226−D,W,Y, Pa−230−W,Y, U−233−D,W, U−234−D,W, U−235−D,W, U−236−D,W, U−238−D,W, Pu−241−Y, Bk−249−W, Cf−253−W,Y, and Es−253−W are not present	−	7E+0	3E−9	−	−	−
		If it is known that Ac−227−D,W,Y, Th−229−W,Y, Th−232−W,Y, Pa−231−W,Y, Cm−248−W, and Cm−250−W are not present	−	−	−	1E−14	−	−
		If, in addition, it is known that Sm−146−W, Gd−148−D,W, Gd−152−D, Th−228−W,Y, Th−230−W,Y, U−232−Y, U−233−Y, U−234−Y, U−235−Y, U−236−Y, U−238−Y, U−Nat−Y, Np−236−W, Np−237−W, Pu−236−W,Y, Pu−238−W,Y, Pu−239−W,Y, Pu−240−W,Y, Pu−242−W,Y, Pu−244−W,Y, Am−241−W, Am−242m−W, Am−243−W, Cm−243−W, Cm−244−W, Cm−245−W, Cm−246−W, Cm−247−W, Bk−247−W, Cf−249−W,Y, Cf−250−W,Y, Cf−251−W,Y, Cf−252−W,Y, and Cf−254−W,Y are not present	−	−	−	1E−13	−	
		If, in addition, it is known that Sm−147−W, Gd−152−W, Pb−210−D, Bi−210m−W, Po−210−D,W, Ra−223−W, Ra−225−W, Ra−226−W, Ac−225−D,W,Y, Th−227−W,Y, U−230−D,W,Y, U−232−D,W, U−Nat−W, Pu−241−W, Cm−240−W, Cm−242−W, Cf−248−W,Y, Es−254−W, Fm−257−W, and Md−258−W are not present	−	−	−	1E−12	−	−

Annual Limits on Intake (ALI) & Derived Air Concentrations (DAC) of
Radionuclides for Occupational Exposure Effluent Concentrations
Concentrations for Release to Sanitary Sewerage (Continued)

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
If, in addition it is known that Fe−60, Sr−90, Cd−113m, Cd−113, In−115, I−129, Cs−134, Sm−145, Sm−147, Gd−148, Gd−152, Hg−194 (organic), Bi−210m, Ra−223, Ra−224, Ra−225, Ac−225, Th−228, Th−230, U−233, U−234, U−235, U−236, U−238, U−Nat, Cm−242, Cf−248, Es−254, Fm−257, and Md−258 are not present			−	−	−	−	1E−6	1E−5

3. If a mixture of radionuclides consists of uranium and its daughters in ore dust (10 μm AMAD particle distribution assumed) prior to chemical separation of the uranium from the ore, the following values may be used for the DAC of the mixture: 6E−11 μCi of gross alpha activity from uranium−238, uranium−234, thorium−230, and radium−226 per milliliter of air; 3E−11 μCi of natural uranium per milliliter of air; or 45 micrograms of natural uranium per cubic meter of air.

4. If the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine, for each radionuclide in the mixture, the ratio between the concentration present in the mixture and the concentration otherwise established in Appendix E for the specific radionuclide when not in a mixture. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1," which is "unity".

Example: If radionuclides "A," "B," and "C" are present in concentrations C_A, C_B, and C_C, and if the applicable DACs are DAC_A, DAC_B, and DAC_C, respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{DAC_A} + \frac{C_B}{DAC_B} + \frac{C_C}{DAC_C} \leq 1$$

SECTION 100. DHS 157 Appendix H Table V is repealed and recreated to read:

TABLE V

Radionuclide	Concentration Curie/Cubic Meter[a/]		
	Column 1	Column 2	Column 3
Total of all radionuclides with less than 5−year half−life	700	*	*
H−3	40	*	*
Co−60	700	*	*
Ni−63	3.5	70	700
Ni−63 in activated metal	35	700	7000
Sr−90	0.04	150	7000
Cs−137	1	44	4600

a/ *Note: To convert the Ci/m3 value to gigabecquerel (GBq) per cubic meter, multiply the Ci/m3 value by 37. There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other radionuclides in Table V determine the waste to be Class C independent of these radionuclides*

SECTION 101. DHS 157 Appendix I is repealed and recreated to read:

Chapter DHS 157
APPENDIX I

Quantities for Use with Decommissioning under Section DHS 157.15

NOTE: To convert μCi to kBq, multiply the μCi value by 37.

Material	Microcurie
Americium−241	0.01
Antimony−122	100
Antimony−124	10
Antimony−125	10
Arsenic−73	100
Arsenic−74	10
Arsenic−76	10
Arsenic−77	100
Barium−131	10
Barium−133	10
Barium−140	10
Bismuth−210	1
Bromine−82	10
Cadmium−109	10
Cadmium−115m	10
Cadmium−115	100
Calcium−45	10
Calcium−47	10
Carbon−14	100
Cerium−141	100
Cerium−143	100
Cerium−144	1
Cesium−131	1,000
Cesium−134m	100
Cesium−134	1
Cesium−135	10
Cesium−136	10
Cesium−137	10
Chlorine−36	10
Chlorine−38	10
Chromium−51	1,000
Cobalt−57	100
Cobalt−58m	10
Cobalt−58	10
Cobalt−60	1
Copper−64	100

Material	Microcurie
Dysprosium−165	10
Dysprosium−166	100
Erbium−169	100
Erbium−171	100
Europium−152 (9.2 h)	100
Europium−152 (13 yr)	1
Europium−154	1
Europium−155	10
Fluorine−18	1,000
Gadolinium−153	10
Gadolinium−159	100
Gallium−72	10
Germanium−68	10
Germanium−71	100
Gold−195	10
Gold−198	100
Gold−199	100
Hafnium−181	10
Holmium−166	100
Hydrogen−3	1,000
Indium−113m	100
Indium−114m	10
Indium−115m	100
Indium−115	10
Iodine−125	1
Iodine−126	1
Iodine−129	0.1
Iodine−131	1
Iodine−132	10
Iodine−133	1
Iodine−134	10
Iodine−135	10
Iridium−192	10
Iridium−194	100
Iron−55	100
Iron−59	10
Krypton−85	100
Krypton−87	10
Lanthanum−140	10
Lutetium−177	100
Manganese−52	10
Manganese−54	10
Manganese−56	10

Material	Microcurie
Mercury−197m	100
Mercury−197	100
Mercury−203	10
Molybdenum−99	100
Neodymium−147	100
Neodymium−149	100
Nickel−59	100
Nickel−63	10
Nickel−65	100
Niobium−93m	10
Niobium−95	10
Niobium−97	10
Osmium−185	10
Osmium−191m	100
Osmium−191	100
Osmium−193	100
Palladium−103	100
Palladium−109	100
Phosphorus−32	10
Platinum−191	100
Platinum−193m	100
Platinum−193	100
Platinum−197m	100
Platinum−197	100
Plutonium−239	0.01
Polonium−210	0.1
Potassium−42	10
Praseodymium−142	100
Praseodymium−143	100
Promethium−147	10
Promethium−149	10
Radium−226	0.01
Rhenium−186	100
Rhenium−188	100
Rhodium−103m	100
Rhodium−105	100
Rubidium−86	10
Rubidium−87	10
Ruthenium−97	100
Ruthenium−103	10
Ruthenium−105	10

Material	Microcurie
Ruthenium−106	1
Samarium−151	10
Samarium−153	100
Scandium−46	10
Scandium−47	100
Scandium−48	10
Selenium−75	10
Silicon−31	100
Silver−105	10
Silver−110m	1
Silver−111	100
Sodium−22	10
Sodium−24	10
Strontium−85	10
Strontium−89	1
Strontium−90	0.1
Strontium−91	10
Strontium−92	10
Sulfur −35	100
Tantalum−182	10
Technetium−96	10
Technetium−97m	100
Technetium−97	100
Technetium−99m	100
Technetium−99	10
Tellurium−125m	10
Tellurium−127m	10
Tellurium−127	100
Tellurium−129m	10
Tellurium−129	100
Tellurium−131m	10
Tellurium−132	10
Terbium−160	10
Thallium−200	100
Thallium−201	100
Thallium−202	100
Thallium−204	10
Thorium (natural)c/	100
Thulium−170	10
Thulium−171	10
Tin−113	10

Material	Microcurie
Tin−125	10
Tungsten−181	10
Tungsten−185	10
Tungsten−187	100
Uranium (natural)d/	100
Uranium−233	0.01
Uranium−234	0.01
Uranium−235	0.01
Vanadium−48	10
Xenon−131m	1,000
Xenon−133	100
Xenon−135	100
Ytterbium−175	100
Yttrium−90	10
Yttrium−91	10
Yttrium−92	100
Yttrium−93	100
Zinc−65	10
Zinc− 69m	100
Zinc−69	1,000
Zirconium−93	10
Zirconium−95	10
Zirconium−97	10
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	0.01
Any radionuclide other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition	0.1

c/ Based on alpha disintegration rate of Th−232, Th−230 and their daughter products.
d/ Based on alpha disintegration rate of U−238, U−234, and U−235

Note: Where there is involved a combination of isotopes in known amounts, the limit for the combination should be derived as follows: Determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of the ratios for all the isotopes in the combination may not exceed "1" — that is, unity.

Section 102. DHS 157 Appendix M is repealed and recreated to read:

Chapter DHS 157
APPENDIX M

Information to be Submitted by Persons Proposing to Conduct Healing Arts Screening

Persons requesting that the department approve a healing arts screening program shall submit the following information and evaluation. Mammography screening, bone density screening and National Cancer Institute approved low dose CT lung screening are exempt from this requirement unless persons under age 18 are involved:

a. Name and address of the applicant and, where applicable, the names and addresses of agents within this state.

b. Diseases or conditions for which the x-ray examinations are to be used in diagnoses.

c. A detailed description of the x-ray examinations proposed in the screening program.

d. A description of the population to be examined in the screening program, which is age, sex, physical condition, and other appropriate information. If the study involves women of reproductive age and the exam involves the trunk of the body, what precautions are being taken to ensure the subjects are not pregnant.

e. An evaluation of any known alternate methods not involving ionizing radiation which could achieve the goals of the screening program and why these methods are not used instead of the x-ray examinations.

f. An evaluation by a medical physicist of the x-ray system to be used in the screening program. The evaluation by the medical physicist shall show that the system satisfies all requirements of this chapter. The evaluation shall include a measurement of patient exposures from the x-ray examinations to be performed. This exposure information must be included in the informed consent papers signed by the subject. An explanation of the risk from the radiation exposure shall be included in the informed consent if the head, neck or trunk is involved in the procedure.

g. The name and address of the individual who will interpret the radiograph or images if any are produced. The interpreting physicians must be licensed in Wisconsin.

h. A description of the procedures to be used in advising the individuals screened and their private practitioners of the healing arts of the results of the screening procedure and any further medical needs indicated.

i. A description of the procedures for the retention or disposition of the radiographs, images, graphs and other records pertaining to the x-ray examinations.

j. An indication of the frequency of screening and the duration of the entire screening program.

k. Human-use committee approval of the screening program if one is required by local policy.

l. A copy of the informed consent information being provided to the subjects.

m. If minors are involved, parental consent is required.

SECTION 103. DHS 157 Appendix O is repealed and recreated to read:

Chapter DHS 157
APPENDIX O

Determination of A_1 and A_2

I. Values of A_1 and A_2 for individual radionuclides, which are the bases for many activity limits elsewhere in these regulations, are given in TABLE VI. The curie (Ci) values specified are obtained by converting from the Terabecquerel (TBq) figure. The curie values are expressed to 3 significant figures to assure that the difference in the TBq and Ci quantities is one tenth of one percent or less. Where values of A_1 or A_2 are unlimited, it is for radiation control purposes only. For nuclear criticality safety, some materials are subject to controls placed on fissile material.

II. (a) For individual radionuclides whose identities are known, but which are not listed in TABLE VI, the determination of the values of A_1 and A_2 requires department approval, except that the values of A_1 and A_2 in TABLE VIII may be used without obtaining department approval.

(b) For individual radionuclides whose identities are known, but which are not listed in Table VII, the exempt material activity concentration and exempt consignment activity values contained in Table VIII may be used. Otherwise, the licensee shall obtain prior department approval of the exempt material activity concentration and exempt consignment activity values for radionuclides not listed in Table VII, before shipping the material.

(c) The licensee shall submit requests for prior approval, described under paragraphs II(a) and II(b) of this Appendix, in writing to the department.

III. In the calculations of A_1 and A_2 for a radionuclide not in TABLE VI, a single radioactive decay chain, in which radionuclides are present in their naturally occurring proportions, and in which no daughter nuclide has a half–life either longer than 10 days, or longer than that of the parent nuclide, shall be considered as a single radionuclide, and the activity to be taken into account, and the A_1 or A_2 value to be applied shall be those corresponding to the parent nuclide of that chain. In the case of radioactive decay chains in which any daughter nuclide has a half–life either longer than 10 days, or greater than that of the parent nuclide, the parent and those daughter nuclides shall be considered as mixtures of different nuclides.

IV. For mixtures of radionuclides whose identities and respective activities are known, the following conditions apply:

(a) For special form radioactive material, the maximum quantity transported in a Type A package is as follows:

$$\sum_i \frac{B(i)}{A_1(i)} \leq 1$$

where $B(i)$ is the activity of radionuclide i in special form, and $A_1(i)$ is the A_1 value for radionuclide i.

(b) For normal form radioactive material, the maximum quantity transported in a Type A package is as follows:

$$\sum_i \frac{B(i)}{A_2(i)} \leq 1$$

where $B(i)$ is the activity of radionuclide i in normal form, and $A_2(i)$ is the value for radionuclide i.

(c) If the package contains both special and normal form radioactive material, the activity that may be transported in a Type A package is as follows:

$$\sum_i \frac{B(i)}{A_1(i)} + \sum_j \frac{C(j)}{A_2(j)} \leq 1$$

where B(i) is the activity of radionuclide i as special form radioactive material, $A_1(i)$ is the A_1 value for radionuclide i, C(j) is the activity of radionuclide j as normal form radioactive material, $A_2(j)$ is the A_2 value for radionuclide j.

(d) Alternatively, the A_1 value for mixtures of special form material may be determined as follows:

$$A_1 \; for \; mixtures \; = \; \frac{1}{\sum_i \frac{f(i)}{A_1(i)}}$$

where f(i) is the fraction of activity of nuclide (i) in the mixture and A_1(i) is the appropriate A_1 value for nuclide i.

(e) Alternatively the A_2 value for mixtures of normal form material may be determined as follows:

$$A_2 \; for \; mixtures \; = \; \frac{1}{\sum_i \frac{f(i)}{A_2(i)}}$$

where f(i) is the fraction of activity for radionuclide (i) in the mixture, and A_2 (i) is the appropriate A_2 value for radionuclide (i).

(f) The exempt activity concentration for mixtures of nuclides may be determined as follows:

$$Exempt \; activity \; concentration \; for \; mixture = \frac{1}{\sum_i \frac{f(i)}{[A\}(i)}}$$

where f(i) is the fraction of activity concentration of radionuclide (i) in the mixture, and [A] is the activity concentration for exempt material containing radionuclide (i).

(g) The activity limit for an exempt consignment for mixtures of radionuclides may be determined as follows:

$$Exempt \;\; consignment \; activity \; limit \; for \; mixture \; = \; \frac{1}{\sum_i \frac{f(i)}{A(i)}}$$

where f(i) is the fraction of activity of radionuclide (i) in the mixture, and A is the activity limit for exempt consignments for radionuclide (i).

V. (a) When the identity of each radionuclide is known, but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest A_1 or A_2 value, as appropriate, for the radionuclides in each group may be used in applying the formulas in paragraph IV. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest A_1 or A_2 values for the alpha emitters and beta/gamma emitters.

(b) When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest [A] (activity concentration for exempt material) or A (activity limit for exempt consignment) value, as appropriate, for the radionuclides in each group may be used in applying the formulas in paragraph IV. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest [A] or A values for the alpha emitters and beta/gamma emitters, respectively.

TABLE VI
A_1 AND A_2 VALUES FOR RADIONUCLIDES

Symbol of Radionuclide	Element and Atomic No.	A1 (TBq)	A1 (Ci)	A2 (TBq)	A2 (Ci)	Specific Activity (TBq/g)	(Ci/g)
Ac–225 (a)	Actinium (89)	$8.0X10^{-1}$	$2.2X10^{1}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$2.1X10^{3}$	$5.8X10^{4}$
Ac–227 (a)		$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-5}$	$2.4X10^{-3}$	2.7	$7.2X10^{1}$
Ac–228		$6.0X10^{-1}$	$1.6X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$8.4X10^{4}$	$2.2X10^{6}$
Ag–105	Silver (47)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$1.1X10^{3}$	$3.0X10^{4}$
Ag–108m (a)		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$9.7X10^{-1}$	$2.6X10^{1}$
Ag–110m (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.8X10^{2}$	$4.7X10^{3}$
Ag–111		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$5.8X10^{3}$	$1.6X10^{5}$
Al–26	Aluminum (13)	$1.0X10^{-1}$	2.7	$1.0X10^{-1}$	2.7	$7.0X10^{-4}$	$1.9X10^{-2}$
Am–241	Americium (95)	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$1.3X10^{-1}$	3.4
Am–242m (a)		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$3.6X10^{-1}$	$1.0X10^{1}$
Am–243 (a)		5.0	$1.4X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$7.4X10^{-3}$	$2.0X10^{-1}$
Ar–37	Argon (18)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.7X10^{3}$	$9.9X10^{4}$
Ar–39		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{1}$	$5.4X10^{2}$	1.3	$3.4X10^{1}$
Ar–41		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.5X10^{6}$	$4.2X10^{7}$
As–72	Arsenic (33)	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$6.2X10^{4}$	$1.7X10^{6}$
As–73		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$8.2X10^{2}$	$2.2X10^{4}$
As–74		1.0	$2.7X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$3.7X10^{3}$	$9.9X10^{4}$
As–76		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$5.8X10^{4}$	$1.6X10^{6}$
As–77		$2.0X10^{1}$	$5.4X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$3.9X10^{4}$	$1.0X10^{6}$
At–211 (a)	Astatine (85)	$2.0X10^{1}$	$5.4X10^{2}$	$5.0X10^{-1}$	$1.4X10^{1}$	$7.6X10^{4}$	$2.1X10^{6}$
Au–193	Gold (79)	7.0	$1.9X10^{2}$	2.0	$5.4X10^{1}$	$3.4X10^{4}$	$9.2X10^{5}$
Au–194		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.5X10^{4}$	$4.1X10^{5}$
Au–195		$1.0X10^{1}$	$2.7X10^{2}$	6.0	$1.6X10^{2}$	$1.4X10^{2}$	$3.7X10^{3}$
Au–198		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$9.0X10^{3}$	$2.4X10^{5}$
Au–199		$1.0X10^{1}$	$2.7X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$7.7X10^{3}$	$2.1X10^{5}$
Ba–131 (a)	Barium (56)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$3.1X10^{3}$	$8.4X10^{4}$
Ba–133		3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	9.4	$2.6X10^{2}$
Ba–133m		$2.0X10^{1}$	$5.4X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.2X10^{4}$	$6.1X10^{5}$
Ba–140 (a)		$5.0X10^{-1}$	$1.4X10^{1}$	$3.0X10^{-1}$	8.1	$2.7X10^{3}$	$7.3X10^{4}$
Be–7	Beryllium (4)	$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{1}$	$5.4X10^{2}$	$1.3X10^{4}$	$3.5X10^{5}$
Be–10		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-1}$	$1.6X10^{1}$	$8.3X10^{-4}$	$2.2X10^{-2}$
Bi–205	Bismuth (83)	$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$1.5X10^{3}$	$4.2X10^{4}$
Bi–206		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$3.8X10^{3}$	$1.0X10^{5}$
Bi–207		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	1.9	$5.2X10^{1}$
Bi–210		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$4.6X10^{3}$	$1.2X10^{5}$
Bi–210m (a)		$6.0X10^{-1}$	$1.6X10^{1}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.1X10^{-5}$	$5.7X10^{-4}$
Bi–212 (a)		$7.0X10^{-1}$	$1.9X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$5.4X10^{5}$	$1.5X10^{7}$
Bk–247	Berkelium (97)	8.0	$2.2X10^{2}$	$8.0X10^{-4}$	$2.2X10^{-2}$	$3.8X10^{-2}$	1.0
Bk–249 (a)		$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{-1}$	8.1	$6.1X10^{1}$	$1.6X10^{3}$
Br–76	Bromine (35)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$9.4X10^{4}$	$2.5X10^{6}$
Br–77		3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$2.6X10^{4}$	$7.1X10^{5}$
Br–82		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{4}$	$1.1X10^{6}$

TABLE VI
A_1 AND A_2 VALUES FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	A1 (TBq)	A1 (Ci)	A2 (TBq)	A2 (Ci)	Specific Activity (TBq/g)	(Ci/g)
C−11	Carbon (6)	1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.1X10^{7}$	$8.4X10^{8}$
C−14		$4.0X10^{1}$	$1.1X10^{3}$	3.0	$8.1X10^{1}$	$1.6X10^{-1}$	4.5
Ca−41	Calcium (20)	Unlimited	Unlimited	Unlimited	Unlimited	$3.1X10^{-3}$	$8.5X10^{-2}$
Ca−45		$4.0X10^{1}$	$1.1X10^{3}$	1.0	$2.7X10^{1}$	$6.6X10^{2}$	$1.8X10^{4}$
Ca−47 (a)		3.0	$8.1X10^{1}$	$3.0X10^{-1}$	8.1	$2.3X10^{4}$	$6.1X10^{5}$
Cd−109	Cadmium (48)	$3.0X10^{1}$	$8.1X10^{2}$	2.0	$5.4X10^{1}$	$9.6X10^{1}$	$2.6X10^{3}$
Cd−113m		$4.0X10^{1}$	$1.1X10^{3}$	$5.0X10^{-1}$	$1.4X10^{1}$	8.3	$2.2X10^{2}$
Cd−115 (a)		3.0	$8.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.9X10^{4}$	$5.1X10^{5}$
Cd−115m		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$9.4X10^{2}$	$2.5X10^{4}$
Ce−139	Cerium (58)	7.0	$1.9X10^{2}$	2.0	$5.4X10^{1}$	$2.5X10^{2}$	$6.8X10^{3}$
Ce−141		$2.0X10^{1}$	$5.4X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.1X10^{3}$	$2.8X10^{4}$
Ce−143		$9.0X10^{-1}$	$2.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.5X10^{4}$	$6.6X10^{5}$
Ce−144 (a)		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$1.2X10^{2}$	$3.2X10^{3}$
Cf−248	Californium (98)	$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$5.8X10^{1}$	$1.6X10^{3}$
Cf−249		3.0	$8.1X10^{1}$	$8.0X10^{-4}$	$2.2X10^{-2}$	$1.5X10^{-1}$	4.1
Cf−250		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{-3}$	$5.4X10^{-2}$	4.0	$1.1X10^{2}$
Cf−251		7.0	$1.9X10^{2}$	$7.0X10^{-4}$	$1.9X10^{-2}$	$5.9X10^{-2}$	1.6
Cf−252		$1.0X10^{-1}$	2.7	$3.0X10^{-3}$	$8.1X10^{-2}$	$2.0X10^{1}$	$5.4X10^{2}$
Cf−253 (a)		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{-2}$	1.1	$1.1X10^{3}$	$2.9X10^{4}$
Cf−254		$1.0X10^{-3}$	$2.7X10^{-2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$3.1X10^{2}$	$8.5X10^{3}$
Cl−36	Chlorine (17)	$1.0X10^{1}$	$2.7X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.2X10^{-3}$	$3.3X10^{-2}$
Cl−38		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$4.9X10^{6}$	$1.3X10^{8}$
Cm−240	Curium (96)	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$7.5X10^{2}$	$2.0X10^{4}$
Cm−241		2.0	$5.4X10^{1}$	1.0	$2.7X10^{1}$	$6.1X10^{2}$	$1.7X10^{4}$
Cm−242		$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{-2}$	$2.7X10^{-1}$	$1.2X10^{2}$	$3.3X10^{3}$
Cm−243		9.0	$2.4X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$1.9X10^{-3}$	$5.2X10^{1}$
Cm−244		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{-3}$	$5.4X10^{-2}$	3.0	$8.1X10^{1}$
Cm−245		9.0	$2.4X10^{2}$	$9.0X10^{-4}$	$2.4X10^{-2}$	$6.4X10^{-3}$	$1.7X10^{-1}$
Cm−246		9.0	$2.4X10^{2}$	$9.0X10^{-4}$	$2.4X10^{-2}$	$1.1X10^{-2}$	$3.1X10^{-1}$
Cm−247 (a)		3.0	$8.1X10^{1}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$3.4X10^{-6}$	$9.3X10^{-5}$
Cm−248		$2.0X10^{-2}$	$5.4X10^{-1}$	$3.0X10^{-4}$	$8.1X10^{-3}$	$1.6X10^{-4}$	$4.2X10^{-3}$
Co−55	Cobalt (27)	$5.0X10^{-1}$	$1.4\ X10^{1}$	$5.0X10^{-1}$	$1.4\ X10^{1}$	$1.1X10^{5}$	$3.1X10^{6}$
Co−56		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.1X10^{3}$	$3.0X10^{4}$
Co−57		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$3.1X10^{2}$	$8.4X10^{3}$
Co−58		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.2X10^{3}$	$3.2X10^{4}$
Co−58m		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$2.2X10^{5}$	$5.9X10^{6}$
Co−60		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.2X10^{1}$	$1.1X10^{3}$
Cr−51	Chromium (24)	$3.0x10^{1}$	$8.1X10^{2}$	$3.0x10^{1}$	$8.1X10^{2}$	$3.4X10^{3}$	$9.2X10^{4}$
Cs−129	Cesium (55)	4.0	$1.1X10^{2}$	4.0	$1.1X10^{2}$	$2.8X10^{4}$	$7.6X10^{5}$
Cs−131		$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{1}$	$8.1X10^{2}$	$3.8X10^{3}$	$1.0X10^{5}$
Cs−132		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$5.7X10^{3}$	$1.5X10^{5}$
Cs−134		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$4.8X10^{1}$	$1.3X10^{3}$

TABLE VI
A_1 AND A_2 VALUES FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	A1 (TBq)	A1 (Ci)	A2 (TBq)	A2 (Ci)	Specific Activity (TBq/g)	(Ci/g)
Cs−134m		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.0X10^{5}$	$8.0X10^{6}$
Cs−135		$4.0X10^{1}$	$1.1X10^{3}$	1.0	$2.7X10^{1}$	$4.3X10^{-5}$	$1.2X10^{-3}$
Cs−136		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$2.7X10^{3}$	$7.3X10^{4}$
Cs−137 (a)		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	3.2	$8.7X10^{1}$
Cu−64	Copper (29)	6.0	$1.6X10^{2}$	1.0	$2.7X10^{1}$	$1.4X10^{5}$	$3.9X10^{6}$
Cu−67		$1.0X10^{1}$	$2.7X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$2.8X10^{4}$	$7.6X10^{5}$
Dy−159	Dysprosium (66)	$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{1}$	$5.4X10^{2}$	$2.1X10^{2}$	$5.7X10^{3}$
Dy−165		$9.0X10^{-1}$	$2.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.0X10^{5}$	$8.2X10^{6}$
Dy−166 (a)		$9.0X10^{-1}$	$2.4X10^{1}$	$3.0X10^{-1}$	8.1	$8.6X10^{3}$	$2.3X10^{5}$
Er−169	Erbium (68)	$4.0X10^{1}$	$1.1X10^{3}$	1.0	$2.7X10^{1}$	$3.1X10^{3}$	$8.3X10^{4}$
Er−171		$8.0X10^{-1}$	$2.2X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$9.0X10^{4}$	$2.4X10^{6}$
Eu−147	Europium (63)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$1.4X10^{3}$	$3.7X10^{4}$
Eu−148		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.0X10^{2}$	$1.6X10^{4}$
Eu−149		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{1}$	$5.4X10^{2}$	$3.5X10^{2}$	$9.4X10^{3}$
Eu−150 (short lived)		2.0	$5.4X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$6.1X10^{4}$	$1.6X10^{6}$
Eu−150 (long lived)		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$6.1X10^{4}$	$1.6X10^{6}$
Eu−152		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	6.5	$1.8X10^{2}$
Eu−152m		$8.0X10^{-1}$	$2.2X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$8.2X10^{4}$	$2.2X10^{6}$
Eu−154		$9.0X10^{-1}$	$2.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	9.8	$2.6X10^{2}$
Eu−155		$2.0X10^{1}$	$5.4X10^{2}$	3.0	$8.1X10^{1}$	$1.8X10^{1}$	$4.9X10^{2}$
Eu−156		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$2.0X10^{3}$	$5.5X10^{4}$
F−18	Fluorine (9)	1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.5X10^{6}$	$9.5X10^{7}$
Fe−52 (a)	Iron (26)	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$2.7X10^{5}$	$7.3X10^{6}$
Fe−55		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$8.8X10^{1}$	$2.4X10^{3}$
Fe−59		$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$1.8X10^{3}$	$5.0X10^{4}$
Fe−60 (a)		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-1}$	5.4	$7.4X10^{-4}$	$2.0X10^{-2}$
Ga−67	Gallium (31)	7.0	$1.9X10^{2}$	3.0	$8.1X10^{1}$	$2.2X10^{4}$	$6.0X10^{5}$
Ga−68		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$1.5X10^{6}$	$4.1X10^{7}$
Ga−72		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.1X10^{5}$	$3.1X10^{6}$
Gd−146 (a)	Gadolinium (64)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.9X10^{2}$	$1.9X10^{4}$
Gd−148		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{-3}$	$5.4X10^{-2}$	1.2	$3.2X10^{1}$
Gd−153		$1.0X10^{1}$	$2.7X10^{2}$	9.0	$2.4X10^{2}$	$1.3X10^{2}$	$3.5X10^{3}$
Gd−159		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.9X10^{4}$	$1.1X10^{6}$
Ge−68 (a)	Germanium (32)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$2.6X10^{2}$	$7.1X10^{3}$
Ge−71		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$5.8X10^{3}$	$1.6X10^{5}$
Ge−77		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.3X10^{5}$	$3.6X10^{6}$
Hf−172 (a)	Hafnium (72)	$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$4.1X10^{1}$	$1.1X10^{3}$
Hf−175		3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$3.9X10^{2}$	$1.1X10^{4}$
Hf−181		2.0	$5.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.3X10^{2}$	$1.7X10^{4}$
Hf−182		Unlimited	Unlimited	Unlimited	Unlimited	$8.1X10^{-6}$	$2.2X10^{-4}$

TABLE VI
A_1 AND A_2 VALUES FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	A1 (TBq)	A1 (Ci)	A2 (TBq)	A2 (Ci)	Specific Activity (TBq/g)	(Ci/g)
Hg−194 (a)	Mercury (80)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.3X10^{-1}$	3.5
Hg−195m (a)		3.0	$8.1X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$1.5X10^{4}$	$4.0X10^{5}$
Hg−197		$2.0X10^{1}$	$5.4X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$9.2X10^{3}$	$2.5X10^{5}$
Hg−197m		$1.0X10^{1}$	$2.7X10^{2}$	$4.0X10^{-1}$	$1.1X10^{1}$	$2.5X10^{4}$	$6.7X10^{5}$
Hg−203		5.0	$1.4X10^{2}$	1.0	$2.7X10^{1}$	$5.1X10^{2}$	$1.4X10^{4}$
Ho−166	Holmium (67)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$2.6X10^{4}$	$7.0X10^{5}$
Ho−166m		$6.0X10^{-1}$	$1.6X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.6X10^{-2}$	1.8
I−123	Iodine (53)	6.0	$1.6X10^{2}$	3.0	$8.1X10^{1}$	$7.1X10^{4}$	$1.9X10^{6}$
I−124		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$9.3X10^{3}$	$2.5X10^{5}$
I−125		$2.0X10^{1}$	$5.4X10^{2}$	3.0	$8.1X10^{1}$	$6.4X10^{2}$	$1.7X10^{4}$
I−126		2.0	$5.4X10^{1}$	1.0	$2.7X10^{1}$	$2.9X10^{3}$	$8.0X10^{4}$
I−129		Unlimited	Unlimited	Unlimited	Unlimited	$6.5X10^{-6}$	$1.8X10^{-4}$
I−131		3.0	$8.1X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$4.6X10^{3}$	$1.2X10^{5}$
I−132		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$3.8X10^{5}$	$1.0X10^{7}$
I−133		$7.0X10^{-1}$	$1.9X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$4.2X10^{4}$	$1.1X10^{6}$
I−134		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$9.9X10^{5}$	$2.7X10^{7}$
I−135 (a)		$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.3X10^{5}$	$3.5X10^{6}$
In−111	Indium (49)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$1.5X10^{4}$	$4.2X10^{5}$
In−113m		4.0	$1.1X10^{2}$	2.0	$5.4X10^{1}$	$6.2X10^{5}$	$1.7X10^{7}$
In−114m (a)		$1.0X10^{1}$	$2.7X10^{2}$	$5.0X10^{-1}$	$1.4X10^{1}$	$8.6X10^{2}$	$2.3X10^{4}$
In−115m		7.0	$1.9X10^{2}$	1.0	$2.7X10^{1}$	$2.2X10^{5}$	$6.1X10^{6}$
Ir−189 (a)	Iridium (77)	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$1.9X10^{3}$	$5.2X10^{4}$
Ir−190		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$2.3X10^{3}$	$6.2X10^{4}$
Ir−192		1.0(c)	$2.7X10^{1}$(c)	$6.0X10^{-1}$	$1.6X10^{1}$	$3.4X10^{2}$	$9.2X10^{3}$
Ir−194		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$3.1X10^{4}$	$8.4X10^{5}$
K−40	Potassium (19)	$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$2.4X10^{-7}$	$6.4X10^{-6}$
K−42		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$2.2X10^{5}$	$6.0X10^{6}$
K−43		$7.0X10^{-1}$	$1.9X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.2X10^{5}$	$3.3X10^{6}$
K-79	Krypton (36)	4.0	$1.1X10^{2}$	2.0	$5.4X10^{1}$	$4.2X10^{4}$	$1.1X10^{6}$
Kr−81		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$7.8X10^{-4}$	$2.1X10^{-2}$
Kr−85		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$1.5X10^{1}$	$3.9X10^{2}$
Kr−85m		8.0	$2.2X10^{2}$	3.0	$8.1X10^{1}$	$3.0X10^{5}$	$8.2X10^{6}$
Kr−87		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$1.0X10^{6}$	$2.8X10^{7}$
La−137	Lanthanum (57)	$3.0X10^{1}$	$8.1X10^{2}$	6.0	$1.6X10^{2}$	$1.6X10^{-3}$	$4.4X10^{-2}$
La−140		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$2.1X10^{4}$	$5.6X10^{5}$
Lu−172	Lutetium (71)	$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$4.2X10^{3}$	$1.1X10^{5}$
Lu−173		8.0	$2.2X10^{2}$	8.0	$2.2X10^{2}$	$5.6X10^{1}$	$1.5X10^{3}$
Lu−174		9.0	$2.4X10^{2}$	9.0	$2.4X10^{2}$	$2.3X10^{1}$	$6.2X10^{2}$
Lu−174m		$2.0X10^{1}$	$5.4X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$2.0X10^{2}$	$5.3X10^{3}$
Lu−177		$3.0X10^{1}$	$8.1X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$4.1X10^{3}$	$1.1X10^{5}$
Mg−28 (a)	Magnesium (12)	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$2.0X10^{5}$	$5.4X10^{6}$
Mn−52	Manganese (25)	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.6X10^{4}$	$4.4X10^{5}$
Mn−53		Unlimited	Unlimited	Unlimited	Unlimited	$6.8X10^{-5}$	$1.8X10^{-3}$

TABLE VI
A_1 AND A_2 VALUES FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	A1 (TBq)	A1 (Ci)	A2 (TBq)	A2 (Ci)	Specific Activity (TBq/g)	(Ci/g)
Mn−54		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$2.9X10^{2}$	$7.7X10^{3}$
Mn−56		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$8.0X10^{5}$	$2.2X10^{7}$
Mo−93	Molybdenum (42)	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{1}$	$5.4X10^{2}$	$4.1X10^{-2}$	1.1
Mo−99 (a) (h)		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.8X10^{4}$	$4.8X10^{5}$
N−13	Nitrogen (7)	$9.0X10^{-1}$	$2.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$5.4X10^{7}$	$1.5X10^{9}$
Na−22	Sodium (11)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$2.3X10^{2}$	$6.3X10^{3}$
Na−24		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$3.2X10^{5}$	$8.7X10^{6}$
Nb−93m	Niobium (41)	$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{1}$	$8.1X10^{2}$	8.8	$2.4X10^{2}$
Nb−94		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$6.9X10^{-3}$	$1.9X10^{-1}$
Nb−95		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.5X10^{3}$	$3.9X10^{4}$
Nb−97		$9.0X10^{-1}$	$2.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$9.9X10^{5}$	$2.7X10^{7}$
Nd−147	Neodymium (60)	6.0	$1.6X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.0X10^{3}$	$8.1X10^{4}$
Nd−149		$6.0X10^{-1}$	$1.6X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$4.5X10^{5}$	$1.2X10^{7}$
Ni−59	Nickel (28)	Unlimited	Unlimited	Unlimited	Unlimited	$3.0X10^{-3}$	$8.0X10^{-2}$
Ni−63		$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{1}$	$8.1X10^{2}$	2.1	$5.7X10^{1}$
Ni−65		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$7.1X10^{5}$	$1.9X10^{7}$
Np−235	Neptunium (93)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$5.2X10^{1}$	$1.4X10^{3}$
Np−236 (short−lived)		$2.0X10^{1}$	$5.4X10^{2}$	2.0	$5.4X10^{1}$	$4.7X10^{-4}$	$1.3X10^{-2}$
Np−236 (long−lived)		9.0	$2.4X10^{2}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$4.7X10^{-4}$	$1.3X10^{-2}$
Np−237		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{-3}$	$5.4X10^{-2}$	$2.6X10^{-5}$	$7.1X10^{-4}$
Np−239		7.0	$1.9X10^{2}$	$4.0X10^{-1}$	$1.1X10^{1}$	$8.6X10^{3}$	$2.3X10^{5}$
Os−185	Osmium (76)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$2.8X10^{2}$	$7.5X10^{3}$
Os−191		$1.0X10^{1}$	$2.7X10^{2}$	2.0	$5.4X10^{1}$	$1.6X10^{3}$	$4.4X10^{4}$
Os−191m		$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{1}$	$8.1X10^{2}$	$4.6X10^{4}$	$1.3X10^{6}$
Os−193		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.0X10^{4}$	$5.3X10^{5}$
Os−194 (a)		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.1X10^{1}$	$3.1X10^{2}$
P−32	Phosphorus (15)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$1.1X10^{4}$	$2.9X10^{5}$
P−33		$4.0X10^{1}$	$1.1X10^{3}$	1.0	$2.7X10^{1}$	$5.8X10^{3}$	$1.6X10^{5}$
Pa−230 (a)	Protactinium (91)	2.0	$5.4X10^{1}$	$7.0X10^{-2}$	1.9	$1.2X10^{3}$	$3.3X10^{4}$
Pa−231		4.0	$1.1X10^{2}$	$4.0X10^{-4}$	$1.1X10^{-2}$	$1.7X10^{-3}$	$4.7X10^{-2}$
Pa−233		5.0	$1.4X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$7.7X10^{2}$	$2.1X10^{4}$
Pb−201	Lead (82)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$6.2X10^{4}$	$1.7X10^{6}$
Pb−202		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{1}$	$5.4X10^{2}$	$1.2X10^{-4}$	$3.4X10^{-3}$
Pb−203		4.0	$1.1X10^{2}$	3.0	$8.1X10^{1}$	$1.1X10^{4}$	$3.0X10^{5}$
Pb−205		Unlimited	Unlimited	Unlimited	Unlimited	$4.5X10^{-6}$	$1.2X10^{-4}$
Pb−210 (a)		1.0	$2.7X10^{1}$	$5.0X10^{-2}$	1.4	2.8	$7.6X10^{1}$
Pb−212 (a)		$7.0X10^{-1}$	$1.9X10^{1}$	$2.0X10^{-1}$	5.4	$5.1X10^{4}$	$1.4X10^{6}$
Pd−103 (a)	Palladium (46)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$2.8X10^{3}$	$7.5X10^{4}$
Pd−107		Unlimited	Unlimited	Unlimited	Unlimited	$1.9X10^{-5}$	$5.1X10^{-4}$
Pd−109		2.0	$5.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$7.9X10^{4}$	$2.1X10^{6}$

TABLE VI
A_1 AND A_2 VALUES FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	A1 (TBq)	A1 (Ci)	A2 (TBq)	A2 (Ci)	Specific Activity (TBq/g)	(Ci/g)
Pm−143	Promethium (61)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$1.3X10^{2}$	$3.4X10^{3}$
Pm−144		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$9.2X10^{1}$	$2.5X10^{3}$
Pm−145		$3.0X10^{1}$	$8.1X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	5.2	$1.4X10^{2}$
Pm−147		$4.0X10^{1}$	$1.1X10^{3}$	2.0	$5.4X10^{1}$	$3.4X10^{1}$	$9.3X10^{2}$
Pm−148m (a)		$8.0X10^{-1}$	$2.2X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$7.9X10^{2}$	$2.1X10^{4}$
Pm−149		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.5X10^{4}$	$4.0X10^{5}$
Pm−151		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.7X10^{4}$	$7.3X10^{5}$
Po−210	Polonium (84)	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$1.7X10^{2}$	$4.5X10^{3}$
Pr−142	Praseodymium (59)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.3X10^{4}$	$1.2X10^{6}$
Pr−143		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.5X10^{3}$	$6.7X10^{4}$
Pt−188 (a)	Platinum (78)	1.0	$2.7X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$2.5X10^{3}$	$6.8X10^{4}$
Pt−191		4.0	$1.1X10^{2}$	3.0	$8.1X10^{1}$	$8.7X10^{3}$	$2.4X10^{5}$
Pt−193		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	1.4	$3.7X10^{1}$
Pt−193m		$4.0X10^{1}$	$1.1X10^{3}$	$5.0X10^{-1}$	$1.4X10^{1}$	$5.8X10^{3}$	$1.6X10^{5}$
Pt−195m		$1.0X10^{1}$	$2.7X10^{2}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.2X10^{3}$	$1.7X10^{5}$
Pt−197		$2.0X10^{1}$	$5.4X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.2X10^{4}$	$8.7X10^{5}$
Pt−197m		$1.0X10^{1}$	$2.7X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.7X10^{5}$	$1.0X10^{7}$
Pu−236	Plutonium (94)	$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{-3}$	$8.1X10^{-2}$	$2.0X10^{1}$	$5.3X10^{2}$
Pu−237		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{1}$	$5.4X10^{2}$	$4.5X10^{2}$	$1.2X10^{4}$
Pu−238		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$6.3X10^{-1}$	$1.7X10^{1}$
Pu−239		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$2.3X10^{-3}$	$6.2X10^{-2}$
Pu−240		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$8.4X10^{-3}$	$2.3X10^{-1}$
Pu−241 (a)		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-2}$	1.6	3.8	$1.0X10^{2}$
Pu−242		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$1.5X10^{-4}$	$3.9X10^{-3}$
Pu−244 (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$6.7X10^{-7}$	$1.8X10^{-5}$
Ra−223 (a)	Radium (88)	$4.0X10^{-1}$	$1.1X10^{1}$	$7.0X10^{-3}$	$1.9X10^{-1}$	$1.9X10^{3}$	$5.1X10^{4}$
Ra−224 (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$5.9X10^{3}$	$1.6X10^{5}$
Ra−225 (a)		$2.0X10^{-1}$	5.4	$4.0X10^{-3}$	$1.1X10^{-1}$	$1.5X10^{3}$	$3.9X10^{4}$
Ra−226 (a)		$2.0X10^{-1}$	5.4	$3.0X10^{-3}$	$8.1X10^{-2}$	$3.7X10^{-2}$	1.0
Ra−228 (a)		$6.0X10^{-1}$	$1.6X10^{1}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$1.0X10^{1}$	$2.7X10^{2}$
Rb−81	Rubidium (37)	2.0	$5.4X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.1X10^{5}$	$8.4X10^{6}$
Rb−83 (a)		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$6.8X10^{2}$	$1.8X10^{4}$
Rb−84		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.8X10^{3}$	$4.7X10^{4}$
Rb−86		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$3.0X10^{3}$	$8.1X10^{4}$
Rb−87		Unlimited	Unlimited	Unlimited	Unlimited	$3.2X10^{-9}$	$8.6X10^{-8}$
Rb(nat)		Unlimited	Unlimited	Unlimited	Unlimited	$6.7X10^{6}$	$1.8X10^{8}$
Re−184	Rhenium (75)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$6.9X10^{2}$	$1.9X10^{4}$
Re−184m		3.0	$8.1X10^{1}$	1.0	$2.7X10^{1}$	$1.6X10^{2}$	$4.3X10^{3}$
Re−186		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$6.9X10^{3}$	$1.9X10^{5}$
Re−187		Unlimited	Unlimited	Unlimited	Unlimited	$1.4X10^{-9}$	$3.8X10^{-8}$
Re−188		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$3.6X10^{4}$	$9.8X10^{5}$

TABLE VI
A_1 AND A_2 VALUES FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	A1 (TBq)	A1 (Ci)	A2 (TBq)	A2 (Ci)	Specific Activity (TBq/g)	(Ci/g)
Re−189 (a)		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.5X10^{4}$	$6.8X10^{5}$
Re(nat)		Unlimited	Unlimited	Unlimited	Unlimited	0.0	$2.4X10^{-8}$
Rh−99	Rhodium (45)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$3.0X10^{3}$	$8.2X10^{4}$
Rh−101		4.0	$1.1X10^{2}$	3.0	$8.1X10^{1}$	$4.1X10^{1}$	$1.1X10^{3}$
Rh−102		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$4.5X10^{1}$	$1.2X10^{3}$
Rh−102m		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$2.3X10^{2}$	$6.2X10^{3}$
Rh−103m		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$1.2X10^{6}$	$3.3X10^{7}$
Rh−105		$1.0X10^{1}$	$2.7X10^{2}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.1X10^{4}$	$8.4X10^{5}$
Rn−222 (a)	Radon (86)	$3.0X10^{-1}$	8.1	$4.0X10^{-3}$	$1.1X10^{-1}$	$5.7X10^{3}$	$1.5X10^{5}$
Ru−97	Ruthenium (44)	5.0	$1.4X10^{2}$	5.0	$1.4X10^{2}$	$1.7X10^{4}$	$4.6X10^{5}$
Ru−103 (a)		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$1.2X10^{3}$	$3.2X10^{4}$
Ru−105		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.5X10^{5}$	$6.7X10^{6}$
Ru−106 (a)		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$1.2X10^{2}$	$3.3X10^{3}$
S−35	Sulphur (16)	$4.0X10^{1}$	$1.1X10^{3}$	3.0	$8.1X10^{1}$	$1.6X10^{3}$	$4.3X10^{4}$
Sb−122	Antimony (51)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.5X10^{4}$	$4.0X10^{5}$
Sb−124		$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$6.5X10^{2}$	$1.7X10^{4}$
Sb−125		2.0	$5.4X10^{1}$	1.0	$2.7X10^{1}$	$3.9X10^{1}$	$1.0X10^{3}$
Sb−126		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$3.1X10^{3}$	$8.4X10^{4}$
Sc−44	Scandium (21)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.7X10^{5}$	$1.8X10^{7}$
Sc−46		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$1.3X10^{3}$	$3.4X10^{4}$
Sc−47		$1.0X10^{1}$	$2.7X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$3.1X10^{4}$	$8.3X10^{5}$
Sc−48		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$5.5X10^{4}$	$1.5X10^{6}$
Se−75	Selenium (34)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$5.4X10^{2}$	$1.5X10^{4}$
Se−79		$4.0X10^{1}$	$1.1X10^{3}$	2.0	$5.4X10^{1}$	$2.6X10^{-3}$	$7.0X10^{-2}$
Si−31	Silicon (14)	$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.4X10^{6}$	$3.9X10^{7}$
Si−32		$4.0X10^{1}$	$1.1X10^{3}$	$5.0X10^{-1}$	$1.4X10^{1}$	3.9	$1.1X10^{2}$
Sm−145	Samarium (62)	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$9.8X10^{1}$	$2.6X10^{3}$
Sm−147		Unlimited	Unlimited	Unlimited	Unlimited	$8.5X10^{-1}$	$2.3X10^{-8}$
Sm−151		$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{1}$	$2.7X10^{2}$	$9.7X10^{-1}$	$2.6X10^{1}$
Sm−153		9.0	$2.4X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.6X10^{4}$	$4.4X10^{5}$
Sn−113 (a)	Tin (50)	4.0	$1.1X10^{2}$	2.0	$5.4X10^{1}$	$3.7X10^{2}$	$1.0X10^{4}$
Sn−117m		7.0	$1.9X10^{2}$	$4.0X10^{-1}$	$1.1X10^{1}$	$3.0X10^{3}$	$8.2X10^{4}$
Sn−119m		$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{1}$	$8.1X10^{2}$	$1.4X10^{2}$	$3.7X10^{3}$
Sn−121m (a)		$4.0X10^{1}$	$1.1X10^{3}$	$9.0X10^{-1}$	$2.4X10^{1}$	2.0	$5.4X10^{1}$
Sn−123		$8.0X10^{-1}$	$2.2X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.0X10^{2}$	$8.2X10^{3}$
Sn−125		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{3}$	$1.1X10^{5}$
Sn−126 (a)		$6.0X10^{-1}$	$1.6X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.0X10^{-3}$	$2.8X10^{-2}$
Sr−82 (a)	Strontium (38)	$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$2.3X10^{3}$	$6.2X10^{4}$
Sr−85		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$8.8X10^{2}$	$2.4X10^{4}$
Sr−85m		5.0	$1.4X10^{2}$	5.0	$1.4X10^{2}$	$1.2X10^{6}$	$3.3X10^{7}$
Sr−87m		3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$4.8X10^{5}$	$1.3X10^{7}$
Sr−89		$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.1X10^{3}$	$2.9X10^{4}$

TABLE VI
A_1 AND A_2 VALUES FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	A1 (TBq)	A1 (Ci)	A2 (TBq)	A2 (Ci)	Specific Activity (TBq/g)	(Ci/g)
Sr–90 (a)		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	5.1	$1.4X10^{2}$
Sr–91 (a)		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.3X10^{5}$	$3.6X10^{6}$
Sr–92 (a)		1.0	$2.7X10^{1}$	$3.0X10^{-1}$	8.1	$4.7X10^{5}$	$1.3X10^{7}$
T(H–3)	Tritium (1)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.6X10^{2}$	$9.7X10^{3}$
Ta–178 (long–lived)	Tantalum (73)	1.0	$2.7X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$4.2X10^{6}$	$1.1X10^{8}$
Ta–179		$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{1}$	$8.1X10^{2}$	$4.1X10^{1}$	$1.1X10^{3}$
Ta–182		$9.0X10^{-1}$	$2.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$2.3X10^{2}$	$6.2X10^{3}$
Tb–157	Terbium (65)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$5.6X10^{-1}$	$1.5X10^{1}$
Tb–158		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$5.6X10^{-1}$	$1.5X10^{1}$
Tb–160		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$4.2X10^{2}$	$1.1X10^{4}$
Tc–95m (a)	Technetium (43)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$8.3X10^{2}$	$2.2X10^{4}$
Tc–96		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.2X10^{4}$	$3.2X10^{5}$
Tc–96m (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.4X10^{6}$	$3.8X10^{7}$
Tc–97		Unlimited	Unlimited	Unlimited	Unlimited	$5.2X10^{-5}$	$1.4X10^{-3}$
Tc–97m		$4.0X10^{1}$	$1.1X10^{3}$	1.0	$2.7X10^{1}$	$5.6X10^{2}$	$1.5X10^{4}$
Tc–98		$8.0X10^{-1}$	$2.2X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$3.2X10^{-5}$	$8.7X10^{-4}$
Tc–99		$4.0X10^{1}$	$1.1X10^{3}$	$9.0X10^{-1}$	$2.4X10^{1}$	$6.3X10^{-4}$	$1.7X10^{-2}$
Tc–99m		$1.0X10^{1}$	$2.7X10^{2}$	4.0	$1.1X10^{2}$	$1.9X10^{5}$	$5.3X10^{6}$
Te–121	Tellurium (52)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$2.4X10^{3}$	$6.4X10^{4}$
Te–121m		5.0	$1.4X10^{2}$	3.0	$8.1X10^{1}$	$2.6X10^{2}$	$7.0X10^{3}$
Te–123m		8.0	$2.2X10^{2}$	1.0	$2.7X10^{1}$	$3.3X10^{2}$	$8.9X10^{3}$
Te–125m		$2.0X10^{1}$	$5.4X10^{2}$	$9.0X10^{-1}$	$2.4X10^{1}$	$6.7X10^{2}$	$1.8X10^{4}$
Te–127		$2.0X10^{1}$	$5.4X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$9.8X10^{4}$	$2.6X10^{6}$
Te–127m (a)		$2.0X10^{1}$	$5.4X10^{2}$	$5.0X10^{-1}$	$1.4X10^{1}$	$3.5X10^{2}$	$9.4X10^{3}$
Te–129		$7.0X10^{-1}$	$1.9X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$7.7X10^{5}$	$2.1X10^{7}$
Te–129m (a)		$8.0X10^{-1}$	$2.2X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.1X10^{3}$	$3.0X10^{4}$
Te–131m (a)		$7.0X10^{-1}$	$1.9X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$3.0X10^{4}$	$8.0X10^{5}$
Te–132 (a)		$5.0X10^{-1}$	$1.4X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.1X10^{4}$	$3.0X10^{5}$
Th–227	Thorium (90)	$1.0X10^{1}$	$2.7X10^{2}$	$5.0X10^{-3}$	$1.4X10^{-1}$	$1.1X10^{3}$	$3.1X10^{4}$
Th–228 (a)		$5.0X10^{-1}$	$1.4X10^{1}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$3.0X10^{1}$	$8.2X10^{2}$
Th–229		5.0	$1.4X10^{2}$	$5.0X10^{-4}$	$1.4X10^{-2}$	$7.9X10^{-3}$	$2.1X10^{-1}$
Th–230		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$7.6X10^{-4}$	$2.1X10^{-2}$
Th–231		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.0X10^{4}$	$5.3X10^{5}$
Th–232		Unlimited	Unlimited	Unlimited	Unlimited	$4.0X10^{-9}$	$1.1X10^{-7}$
Th–234 (a)		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$8.6X10^{2}$	$2.3X10^{4}$
Th(nat)		Unlimited	Unlimited	Unlimited	Unlimited	$8.1X10^{-9}$	$2.2X10^{-7}$
Ti–44 (a)	Titanium (22)	$5.0X10^{-1}$	$1.4X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	6.4	$1.7X10^{2}$
Tl–200	Thallium (81)	$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$2.2X10^{4}$	$6.0X10^{5}$
Tl–201		$1.0X10^{1}$	$2.7X10^{2}$	4.0	$1.1X10^{2}$	$7.9X10^{3}$	$2.1X10^{5}$
Tl–202		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$2.0X10^{3}$	$5.3X10^{4}$
Tl–204		$1.0X10^{1}$	$2.7X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$1.7X10^{1}$	$4.6X10^{2}$

TABLE VI
A_1 AND A_2 VALUES FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	A1 (TBq)	A1 (Ci)	A2 (TBq)	A2 (Ci)	Specific Activity (TBq/g)	(Ci/g)
Tm–167	Thulium (69)	7.0	$1.9X10^{2}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.1X10^{3}$	$8.5X10^{4}$
Tm–170		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.2X10^{2}$	$6.0X10^{3}$
Tm–171		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$
U–230 (fast lung absorption) (a)(d)	Uranium (92)	$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{-1}$	2.7	$1.0X10^{3}$	$2.7X10^{4}$
U–230 (medium lung absorption) (a)(e)		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{-3}$	$1.1X10^{-1}$	$1.0X10^{3}$	$2.7X10^{4}$
U–230 (slow lung absorption) (a)(f)		$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{-3}$	$8.1X10^{-2}$	$1.0X10^{3}$	$2.7X10^{4}$
U–232 (fast lung absorption) (d)		$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{-2}$	$2.7X10^{-1}$	$8.3X10^{-1}$	$2.2X10^{1}$
U–232 (medium lung absorption) (e)		$4.0X10^{1}$	$1.1X10^{3}$	$7.0X10^{-3}$	$1.9X10^{-1}$	$8.3X10^{-1}$	$2.2X10^{1}$
U–232 (slow lung absorption) (f)		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$8.3X10^{-1}$	$2.2X10^{1}$
U–233 (fast lung absorption) (d)		$4.0X10^{1}$	$1.1X10^{3}$	$9.0X10^{-2}$	2.4	$3.6X10^{-4}$	$9.7X10^{-3}$
U–233 (medium lung absorption) (e)		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$3.6X10^{-4}$	$9.7X10^{-3}$
U–233 (slow lung absorption) (f)		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$3.6X10^{-4}$	$9.7X10^{-3}$
U–234 (fast lung absorption) (d)		$4.0X10^{1}$	$1.1X10^{3}$	$9.0X10^{-2}$	2.4	$2.3X10^{-4}$	$6.2X10^{-3}$
U–234 (medium lung absorption) (e)		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.3X10^{-4}$	$6.2X10^{-3}$
U–234 (slow lung absorption) (f)		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$2.3X10^{-4}$	$6.2X10^{-3}$
U–235 (all lung absorption types) (a),(d),(e),(f)		Unlimited	Unlimited	Unlimited	Unlimited	$8.0X10^{-8}$	$2.2X10^{-6}$
U–236 (fast lung absorption) (d)		Unlimited	Unlimited	Unlimited	Unlimited	$2.4X10^{-6}$	$6.5X10^{-5}$
U–236 (medium lung absorption) (e)		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.4X10^{-6}$	$6.5X10^{-5}$

TABLE VI
A_1 AND A_2 VALUES FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	A1 (TBq)	A1 (Ci)	A2 (TBq)	A2 (Ci)	Specific Activity (TBq/g)	(Ci/g)
U–236 (slow lung absorption) (f)		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$2.4X10^{-6}$	$6.5X10^{-5}$
U–238 (all lung absorption types) (d),(e),(f)		Unlimited	Unlimited	Unlimited	Unlimited	$1.2X10^{-8}$	$3.4X10^{-7}$
U (nat)		Unlimited	Unlimited	Unlimited	Unlimited	$2.6X10^{-8}$	$7.1X10^{-7}$
U (enriched to 20% or less)(g)		Unlimited	Unlimited	Unlimited	Unlimited	N/A	N/A
U (dep)		Unlimited	Unlimited	Unlimited	Unlimited	0.0	(See Table IX)
V–48	Vanadium (23)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$6.3X10^{3}$	$1.7X10^{5}$
V–49		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{2}$	$8.1X10^{3}$
W–178 (a)	Tungsten (74)	9.0	$2.4X10^{2}$	5.0	$1.4X10^{2}$	$1.3X10^{3}$	$3.4X10^{4}$
W–181		$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{1}$	$8.1X10^{2}$	$2.2X10^{2}$	$6.0X10^{3}$
W–185		$4.0X10^{1}$	$1.1X10^{3}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.5X10^{2}$	$9.4X10^{3}$
W–187		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.6X10^{4}$	$7.0X10^{5}$
W–188 (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$3.0X10^{-1}$	8.1	$3.7X10^{2}$	$1.0X10^{4}$
Xe–122 (a)	Xenon (54)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.8X10^{4}$	$1.3X10^{6}$
Xe–123		2.0	$5.4X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$4.4X10^{5}$	$1.2X10^{7}$
Xe–127		4.0	$1.1X10^{2}$	2.0	$5.4X10^{1}$	$1.0X10^{3}$	$2.8X10^{4}$
Xe–131m		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.1X10^{3}$	$8.4X10^{4}$
Xe–133		$2.0X10^{1}$	$5.4X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$6.9X10^{3}$	$1.9X10^{5}$
Xe–135		3.0	$8.1X10^{1}$	2.0	$5.4X10^{1}$	$9.5X10^{4}$	$2.6X10^{6}$
Y–87 (a)	Yttrium (39)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.7X10^{4}$	$4.5X10^{5}$
Y–88		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$5.2X10^{2}$	$1.4X10^{4}$
Y–90		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$2.0X10^{4}$	$5.4X10^{5}$
Y–91		$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$9.1X10^{2}$	$2.5X10^{4}$
Y–91m		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$1.5X10^{6}$	$4.2X10^{7}$
Y–92		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$3.6X10^{5}$	$9.6X10^{6}$
Y–93		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.2X10^{5}$	$3.3X10^{6}$
Yb–169	Ytterbium (79)	4.0	$1.1X10^{2}$	1.0	$2.7X10^{1}$	$8.9X10^{2}$	$2.4X10^{4}$
Yb–175		$3.0X10^{1}$	$8.1X10^{2}$	$9.0X10^{-1}$	$2.4X10^{1}$	$6.6X10^{3}$	$1.8X10^{5}$
Zn–65	Zinc (30)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$3.0X10^{2}$	$8.2X10^{3}$
Zn–69		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.8X10^{6}$	$4.9X10^{7}$
Zn–69m (a)		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.2X10^{5}$	$3.3X10^{6}$
Zr–88	Zirconium (40)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$6.6X10^{2}$	$1.8X10^{4}$
Zr–93		Unlimited	Unlimited	Unlimited	Unlimited	$9.3X10^{-5}$	$2.5X10^{-3}$
Zr–95 (a)		2.0	$5.4X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$7.9X10^{2}$	$2.1X10^{4}$
Zr–97 (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$7.1X10^{4}$	$1.9X10^{6}$

NOTES

(a) A_1 and/or A_2 values include contributions from daughter nuclides with half–lives less than 10 days, as listed in the following:

Mg-28	Al-28
Ca-47	Sc-47
Ti-44	Sc-44
Fe-52	Mn-52m
Fe-60	Co-60m
Zn-69m	Zn-69
Ge-68	Ga-68
Rb-83	Kr-83m
Sr-82	Rb-82
Sr-90	Y-90
Sr-91	Y-91m
Sr-92	Y-92
Y-87	Sr-87m
Zr-95	Nb-95m
Zr-97	Nb-97m, Nb-97
Mo-99	Tc-99m
Tc-95m	Tc-95
Tc-96m	Tc-96
Ru-103	Rh-103m
Ru-106	Rh-106
Pd-103	Rh-103m
Ag-108m	Ag-108
Ag-110m	Ag-110
Cd-115	In-115m
In-114m	In-114
Sn-113	In-113m
Sn-121m	Sn-121
Sn-126	Sb-126m
Te-127m	Te-127
Te-129m	Te-129
Te-131m	Te-131
Te-132	I-132
I-135	Xe-135m
Xe-122	I-122
Cs-137	Ba-137m
Ba-131	Cs-131
Ba-140	La-140
Ce-144	Pr-144m, Pr-144
Pm-148m	Pm-148
Gd-146	Eu-146
Dy-166	Ho-166
Hf-172	Lu-172
W-178	Ta-178
W-188	Re-188

Re-189	Os-189m
Os-194	Ir-194
Ir-189	Os-189m
Pt-188	Ir-188
Hg-194	Au-194
Hg-195m	Hg-195
Pb-210	Bi-210
Pb-212	Bi-212, Tl-208, Po-212
Bi-210m	Tl-206
Bi-212	Tl-208, Po-212
At-211	Po-211
Rn-222	Po-218, Pb-214, At-218, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Po-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
Ra-225	Ac-225, Fr-221, At-217, Bi-213, Tl-209, Po-213, Pb-209
Ra-226	Rn-222, Po-218, Pb-214, At-218, Bi-214, Po-214
Ra-228	Ac-228
Ac-225	Fr-221, At-217, Bi-213, Tl-209, Po-213, Pb-209
Ac-227	Fr-223
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
Th-234	Pa-234m, Pa-234
Pa-230	Ac-226, Th-226, Fr-222, Ra-222, Rn-218, Po-214
U-230	Th-226, Ra-222, Rn-218, Po-214
U-235	Th-231
Pu-241	U-237
Pu-244	U-240, Np-240m
Am-242m	Am-242, Np-238
Am-243	Np-239
Cm-247	Pu-243
Bk-249	Am-245
Cf-253	Cm-249

(b) The values of A_1 and A_2 in curies (Ci) are approximate and for information only; the regulatory standard units are Terabecquerels (TBq).

(c) The activity of Ir-192 in special form may be determined from a measurement of the rate of decay or a measurement of the radiation level at a prescribed distance from the source.

(d) These values apply only to compounds of uranium that take the chemical form of UF_6, UO_2F_2 and $UO_2(NO_3)^2$ in both normal and accident conditions of transport.

(e) These values apply only to compounds of uranium that take the chemical form of UO_3, UF_4, UCl^4, and hexavalent compounds in both normal and accident conditions of transport.

(f) These values apply to all compounds of uranium other than those specified in (d) and (e), above.

(g) These values apply to unirradiated uranium only.

(h) $A_2 = 0.74$ TBq (20 Ci) for Mo−99 for domestic use.

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Ac–225	Actinium (89)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Ac–227		$1.0X10^{-1}$	$2.7X10^{-12}$	$1.0X10^{3}$	$2.7X10^{-8}$
Ac–228		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ag–105	Silver (47)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ag–108m (a)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ag–110m		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ag–111		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Al–26	Aluminum (13)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Am–241	Americium (95)	1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Am–242m (a)		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Am–243 (a)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Ar–37	Argon (18)	$1.0X10^{6}$	$2.7X10^{-5}$	$1.0X10^{8}$	$2.7X10^{-3}$
Ar–39		$1.0X10^{7}$	$2.7X10^{-4}$	$1.0X10^{4}$	$2.7X10^{-7}$
Ar–41		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{9}$	$2.7X10^{-2}$
As–72	Arsenic (33)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
As–73		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
As–74		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
As–76		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
As–77		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
At–211	Astatine (85)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Au–193	Gold (79)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Au–194		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Au–195		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Au–198		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Au–199		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Be–7	Beryllium (4)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Be–10		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Bi–205	Bismuth (83)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Bi–206		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Bi–207		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Bi–210		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Bi–210m		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Bi–212 (a)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ba–131	Barium (56)	$1.0X10^{2}$	$2.7X10^{-9}$	1.0X106	$2.7X10^{-5}$
Ba–133		$1.0X10^{2}$	$2.7X10^{-9}$	1.0X106	$2.7X10^{-5}$
Ba–133m		$1.0X10^{2}$	$2.7X10^{-9}$	1.0X106	$2.7X10^{-5}$
Ba–140 (a)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Bk–247	Berkelium (97)	1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Bk–249		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Br–76	Bromine (35)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Br–77		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Br−82		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
C−11	Carbon (6)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
C−14		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ca−41	Calcium (20)	$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ca−45		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ca−47		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cd−109	Cadmium (48)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cd−113m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cd−115		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cd−115m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ce−139	Cerium (58)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ce−141		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ce−143		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ce−144 (a)		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cf−248	Californium (98)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cf−249		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Cf−250		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cf−251		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Cf−252		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cf−253		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cf−254		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Cl−36	Chlorine (17)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cl−38		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cm−240	Curium (96)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cm−241		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cm−242		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cm−243		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cm−244		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cm−245		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Cm−246		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Cm−247		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cm−248		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Co−55	Cobalt (27)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Co−56		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Co−57		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Co−58		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Co−58m		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Co−60		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cr−51	Chromium (24)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Cs−129	Cesium (55)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Cs−131		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cs−132		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cs−134		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cs−134m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cs−135		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Cs−136		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cs−137 (a)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cu−64	Copper (29)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cu−67		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Dy−159	Dysprosium (66)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Dy−165		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Dy−166		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Er−169	Erbium (68)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Er−171		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu−147	Europium (63)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu−148		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu−149		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Eu−150 (short lived)		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu−150 (long lived)		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu−152		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu−152 m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu−154		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu−155		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Eu−156		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
F−18	Fluorine (9)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Fe−52	Iron (26)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Fe−55		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Fe−59		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Fe−60		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ga−67	Gallium (31)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ga−68		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ga−72		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Gd−146	Gadolinium (64)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Gd−148		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Gd−153		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Gd−159		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ge−68	Germanium (32)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ge−71		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{8}$	$2.7X10^{-3}$

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Ge−77		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Hf−172	Hafnium (72)	$1.0X10^{2}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hf−175		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hf−181		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hf−182		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hg−194	Mercury (80)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hg−195m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hg−197		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Hg−197m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hg−203		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ho−166	Holmium (67)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ho−166m		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
I−123	Iodine (53)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
I−124		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
I−125		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
I−126		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
I−129		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
I−131		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
I−132		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
I−133		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
I−134		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
I−135		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
In−111	Indium (49)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
In−113m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
In−114m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
In−115m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ir−189	Iridium (77)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ir−190		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ir−192		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Ir−194		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
K−40	Potassium (19)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
K−42		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
K−43		$1.0X10^{2}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Kr−79	Krypton (36)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
Kr−81		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Kr−85		$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{4}$	$2.7X10^{-7}$
Kr−85m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{10}$	$2.7X10^{-1}$
Kr−87		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{9}$	$2.7X10^{-2}$
La−137	Lanthanum (57)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
La−140		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Lu−172	Lutetium (71)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Lu−173		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Lu−174		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Lu−174m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Lu−177		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Mg−28	Magnesium (12)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Mn−52	Manganese (25)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Mn−53		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{9}$	$2.7X10^{-2}$
Mn−54		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Mn−56		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Mo−93	Molybdenum (42)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{8}$	$2.7X10^{-3}$
Mo−99		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
N−13	Nitrogen (7)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{9}$	$2.7X10^{-2}$
Na−22	Sodium (11)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Na−24		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Nb−93m	Niobium (41)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Nb−94		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Nb−95		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Nb−97		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Nd−147	Neodymium (60)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Nd−149		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ni−59	Nickel (28)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{8}$	$2.7X10^{-3}$
Ni−63		$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{8}$	$2.7X10^{-3}$
Ni−65		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Np−235	Neptunium (93)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Np−236 (short−lived)		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Np−236 (long−lived)		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Np−237 (a)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Np−239		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Os−185	Osmium (76)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Os−191		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Os−191m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Os−193		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Os−194		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
P−32	Phosphorus (15)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
P−33		$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{8}$	$2.7X10^{-3}$
Pa−230	Protactinium (91)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pa−231		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Pa−233		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Pb−201	Lead (82)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pb−202		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pb−203		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pb−205		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pb−210 (a)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pb−212 (a)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Pd−103	Palladium (46)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{8}$	$2.7X10^{-3}$
Pd−107		$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{8}$	$2.7X10^{-3}$
Pd−109		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pm−143	Promethium (61)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pm−144		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pm−145		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pm−147		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pm−148m		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pm−149		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pm−151		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Po−210	Polonium (84)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pr−142	Praseodymium (59)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Pr−143		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pt−188	Platinum (78)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pt−191		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pt−193		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pt−193m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pt−195m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pt−197		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pt−197m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pu−236	Plutonium (94)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pu−237		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pu−238		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pu−239		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pu−240		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Pu−241		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Pu−242		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pu−244		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Ra−223 (a)	Radium (88)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ra−224 (a)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ra−225		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ra−226 (a)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Ra−228 (a)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Rb−81	Rubidium (37)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Rb−83		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rb−84		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rb−86		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Rb−87		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Rb(nat)		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Re−184	Rhenium (75)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Re−184m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Re−186		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Re−187		$1.0X10^{6}$	$2.7X10^{-5}$	$1.0X10^{9}$	$2.7X10^{-2}$
Re−188		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Re−189		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Re(nat)		$1.0X10^{6}$	$2.7X10^{-5}$	$1.0X10^{9}$	$2.7X10^{-2}$
Rh−99	Rhodium (45)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rh−101		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Rh−102		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rh−102m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rh−103m		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{8}$	$2.7X10^{-3}$
Rh−105		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Rn−222 (a)	Radon (86)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{8}$	$2.7X10^{-3}$
Ru−97	Ruthenium (44)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ru−103		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ru−105		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ru−106 (a)		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
S−35	Sulphur (16)	$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{8}$	$2.7X10^{-3}$
Sb−122	Antimony (51)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{4}$	$2.7X10^{-7}$
Sb−124		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sb−125		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sb−126		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sc−44	Scandium (21)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sc−46		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sc−47		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sc−48		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Se−75	Selenium (34)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Se−79		$1.0X10^{4}$	$2.7X10^{-10}$	$1.0X10^{7}$	$2.7X10^{-4}$
Si−31	Silicon (14)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Si−32		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sm−145	Samarium (62)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Sm−147		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Sm−151		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{8}$	$2.7X10^{-3}$
Sm−153		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Sn−113	Tin (50)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Sn−117m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sn−119m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Sn−121m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Sn−123		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sn−125		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sn−126		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sr−82	Strontium (38)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sr−85		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sr−85m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Sr−87m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sr−89		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sr−90 (a)		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{4}$	$2.7X10^{-7}$
Sr−91		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sr−92		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
T(H−3)	Tritium (1)	$1.0X10^{6}$	$2.7X10^{-5}$	$1.0X10^{9}$	$2.7X10^{-2}$
Ta−178 (long−lived)	Tantalum (73)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ta−179		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ta−182		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Tb−157	Terbium (65)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Tb−158		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tb−160		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tc−95m	Technetium (43)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tc−96		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tc−96m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Tc−97		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{8}$	$2.7X10^{-3}$
Tc−97m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Tc−98		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tc−99		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Tc−99m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Te−121	Tellurium (52)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Te−121m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Te−123m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Te−125m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Te−127		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Te−127m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Te−129		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Te−129m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Te−131m		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Te−132		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Th−227	Thorium (90)	1.0X10 [1]	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Th−228 (a)		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Th−229 (a)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Th−230		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Th−231		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Th−232		1.0X10 [1]	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Th−234 (a)		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
Th (nat) (a)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Ti−44	Titanium (22)	1.0X10 [1]	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Tl−200	Thallium (81)	1.0X10 [1]	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tl−201		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tl−202		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tl−204		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{4}$	$2.7X10^{-7}$
Tm−167	Thulium (69)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tm−170		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tm−171		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{8}$	$2.7X10^{-3}$
U−230 (fast lung absorption)(a), (b)	Uranium (92)	1.0X10 [1]	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
U−230 (medium lung absorption)(c)		1.0X10 [1]	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
U−230 (slow lung absorption)(d)		1.0X10 [1]	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
U−232 (fast lung absorption)(a), (b)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
U−232 (medium lung absorption)(c)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
U−232 (slow lung absorption)(d)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
U−233 (fast lung absorption)(b)		1.0X10 [1]	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U−233 (medium lung absorption)(c)		1.0X10 [1]	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U−233 (slow lung absorption)(d)		1.0X10 [1]	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
U–234 (fast lung absorption)(b)	Uranium (92)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U–234 (medium lung absorption)(c)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U–234 (slow lung absorption)(d)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U–235 (all lung absorption types) (a),(b),(c),(d)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U–236 (fast lung absorption)(b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U–236 (medium lung absorption)(c)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U–236 (slow lung absorption)(d)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U–238 (all lung absorption types) (a), (b),(c),(d)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U (nat)(a)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
U (enriched to 20% or less)(e)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
U (dep)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
V–48	Vanadium (23)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
V–49		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
W–178	Tungsten (74)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
W–181		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
W–185		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
W–187		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
W–188		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Xe–122	Xenon (54)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{9}$	$2.7X10^{-2}$
Xe–123		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{9}$	$2.7X10^{-2}$
Xe–127		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
Xe–131m		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{4}$	$2.7X10^{-7}$
Xe–133		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{4}$	$2.7X10^{-7}$
Xe–135		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{10}$	$2.7X10^{-1}$
Y–87	Yttrium (39)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Y–88		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Y–90		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$

TABLE VII
EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES (Continued)

Symbol of Radionuclide	Element and Atomic No.	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Y–91		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Y–91m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Y–92		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Y–93		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Yb–169	Ytterbium (79)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Yb–175		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Zn–65	Zinc (30)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Zn–69		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Zn–69m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Zr–88	Zirconium (40)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Zr–93(a)		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Zr–95		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Zr–97 (a)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$

NOTES

(a) Parent nuclides and their progeny included in secular equilibrium are listed in the following:

Sr-90	Y-90
Zr-93	Nb-93m
Zr-97	Nb-97
Ru-106	Rh-106
Ag-108m	Ag-108
Cs-137	Ba-137m
Ce-144	Pr-144
Ba-140	La-140
Bi-212	Tl-208 (0.36), Po-212 (0.64)
Pb-210	Bi-210, Po-210
Pb-212	Bi-212, Tl-208 (0.36), Po-212 (0.64)
Rn-222	Po-218, Pb-214, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-229	Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-nat	Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-234	Pa-234m
U-230	Th-226, Ra-222, Rn-218, Po-214
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
U-235	Th-231
U-238	Th-234, Pa-234m
U-nat	Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210

Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

(b) These values apply only to compounds of uranium that take the chemical form of UF_6, UO_2F_2, and $UO_2(NO_3)_2$ in both normal and accident conditions of transport.

(c) These values apply only to compounds of uranium that take the chemical form of UO3, UF4, UCl4, and hexavalent compounds in both normal and accident conditions of transport.

(d) These values apply to all compounds of uranium other than those specified in (d) and (e), above.

(e) These values apply to unirradiated uranium only.

TABLE VIII
GENERAL VALUES FOR A_1 AND A_2

Contents		Only beta or gamma emitting radionuclides are known to be present	Alpha emitting nuclides, but no neutron emitters, are known to be present. (a)	Neutron emitting nuclides are known to be present or no relevant data are available
A_1	(TBq)	1×10^{-1}	2×10^{-1}	1×10^{-3}
	(Ci)	2.7×10^{0}	5.4×10^{0}	$2.7 \times 10^{-}$
A_2	(TBq)	2×10^{-2}	9×10^{-5}	9×10^{-5}
	(Ci)	5.4×10^{-1}	2.4×10^{-3}	2.4×10^{-3}
Activity concentration for exempt material (Bq/g)		1×10^{1}	1×10^{-1}	1×10^{-1}
Activity concentration for exempt material (Ci/g)		2.7×10^{-10}	2.7×10^{-12}	2.7×10^{-12}
Activity limits for exempt consignments (Bq)		1×10^{4}	1×10^{3}	1×10^{3}
Activity limits for exempt consignments (Ci)		2.7×10^{-7}	$2.7 \times 10^{-}$	2.7×10^{-8}

(a) If beta or gamma emitting nuclides are known to be present, the A1 value of 0.1 TBq (2.7 Ci) should be used.

TABLE IX
ACTIVITY–MASS RELATIONSHIPS FOR URANIUM

Uranium Enrichment* wt % U–235 present	Specific Activity	
	TBq/g	Ci/g
0.45	1.9×10^{-8}	5.0×10^{-7}
0.72	2.6×10^{-8}	7.1×10^{-7}
1 2.	8×10^{-8}	7.6×10^{-7}
1.5	3.7×10^{-8}	1.0×10^{-6}
5	1.0×10^{-7}	2.7×10^{-6}
10	1.8×10^{-7}	4.8×10^{-6}
20	3.7×10^{-7}	1.0×10^{-5}
35	7.4×10^{-7}	2.0×10^{-5}
50	9.3×10^{-7}	2.5×10^{-5}
90	2.1×10^{-6}	5.8×10^{-5}
93	2.6×10^{-6}	7.0×10^{-5}
95	3.4×10^{-6}	9.1×10^{-5}
Natural thorium	8.1×10^{-9}	2.2×10^{-7}

Note: The figures for uranium include representative values for the activity of the uranium–234 that is concentrated during the enrichment process.

SECTION 104. DHS 157 Appendix U is created to read:

Chapter DHS 157
APPENDIX U

Category 1 and Category 2 Quantity of Radioactive Material Thresholds

The sum of fractions' methodology for evaluating combinations of multiple sources, aggregated sources, or multiple radionuclides is to be used in determining whether a location meets or exceeds the threshold and is thus subject to the requirements of subch. XV. Category 1 and category 2 quantities of radioactive material do not include the radioactive material contained in any fuel assembly, subassembly, fuel rod, or fuel pellet. The terabecquerel (TBq) values are the regulatory standard. The curie (Ci) values specified are obtained by converting from the TBq value. The curie values are provided for practical usefulness only.

Radioactive material	Category 1 (TBq)	Category 1 (Ci)	Category 2 (TBq)	Category 2 (Ci)
Americium-241	60	1,620	0.6	16.2
Americium-241/Be	60	1,620	0.6	16.2
Californium-252	20	540	0.2	5.40
Cobalt-60	30	810	0.3	8.10
Curium-244	50	1,350	0.5	13.5
	100	2,700	1	27.0
Cesium-137	1,000	27,000	10	270
Gadolinium-153	80	2,160	0.8	21.6
Iridium-192	60	1,620	0.6	16.2
Plutonium-238	60	1,620	0.6	16.2
Plutonium-239/Be	40,000	1,080,000	400	10,800
Promethium-147	40	1,080	0.4	10.8
Radium-226	200	5,400	2	54.0
Selenium-75	1,000	27,000	10	270
Strontium-90	20,000	540,000	200	5,400
Thulium-170	300	8,100	3	81.0
Ytterbium-169				

Note: *Calculations Concerning Multiple Sources or Multiple Radionuclides*

I. If multiple sources of the same radionuclide or multiple radionuclides are aggregated at a location, the sum of the ratios of the total activity of each of the radionuclides shall be determined to verify whether the activity at the location is less than the category 1 or category 2 thresholds of Appendix U, as appropriate. If the calculated sum of the ratios, using the equation below, is greater than or equal to 1.0, then the applicable requirements of subch. XV apply.

II. First determine the total activity for each radionuclide from Appendix U. This is done by adding the activity of each individual source, material in any device, and any loose or bulk material that contains the radionuclide. Then use the equation below to calculate the sum of the ratios by inserting the total activity of the applicable radionuclides from Appendix U in the numerator of the equation and the corresponding threshold activity from Table 1 in the denominator of the equation. Calculations shall be performed in metric values (i.e., TBq) and the numerator and denominator values shall be in the same units.

R_1 = total activity for radionuclide 1
R_2 = total activity for radionuclide 2
R_N = total activity for radionuclide n
AR_1 = activity threshold for radionuclide 1
AR_2 = activity threshold for radionuclide 2
AR_N = activity threshold for radionuclide n

$$\sum_{1}^{n}\left[\frac{R_1}{AR_1}+\frac{R_2}{AR_2}+\frac{R_n}{AR_n}\right]\geq 1.0$$

SECTION 105. EFFECTIVE DATE: This rule shall take effect on the first day of the month following publication in the Wisconsin administrative register, as provided in s. 227.22 (2), Stats..